Volume 24, Number 5, March 15, 1970

NUCLEAR SCIENCE ABSTRACTS

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Personal Authors

Each author's name is indexed in the form appearing on the document abstracted:

```
ISHIHARA, T.
  Accumulation of fallout 137Cs in newborn infants,
    23:50538
ISHIHARA, Toyokuki
  Shielding effect of paraffin, water, soil, concrete, Fe,
    and Pb for high-energy neutrons,  23:51748
```

Subjects

The subject index consisting of specific materials, objects, and processes is arranged alphabetically. Modifying phrases specific to these subjects in turn are arranged alphabetically under the subjects.

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MELPHALAN
  effects on proliferation of cultured antigen-stimulated
    spleen cells from mice, dose-response curve for,
    23:50820
MEMBRANE FILTERS
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    (UCRL-18667, pp 322-9)
MEMBRANES
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  radiation effects on permeability of potassium ions
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MENDELEVIUM
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    pp 277-312)
  stability of divalent state of,  23:49772 (UCRL-18667, pp
    277-312)
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Corporate Authors

Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

51093 (LA-4164) FABRICATION OF BORON CARBIDE RINGS AND DISKS. Sheinberg, H.; Herrera, T.; Kostacopoulos, J. (Los Alamos Scientific Lab., N. Mex.). Apr. 25, 1969. Contract W-7405-eng-36. 11p. Dep. CFSTI.

is indexed as:

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LOS ALAMOS SCIENTIFIC LAB., N. MEX.
  Fabrication of boron carbide rings and disks,  23:51093
    (LA-4164)
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Report Numbers

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JPRS-          (Non-AEC)
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  743          23-52447  For translation see EURFNR-613
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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, June 26, 1969.

Volume 24, Number 5 March 15, 1970

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstract 7589.

Chemical and Spectral Procedures

Refer also to abstracts 7492, 7785, and 8066.

7394 (AECL–3431) HIGH SENSITIVITY ATOMIC ABSORPTION SPECTROSCOPY VIA CONTINUOUS SAMPLE PRECONCENTRATION. II. CONTINUOUS SOLVENT EXTRACTION. Mislan, J. P.; Elchuk, S. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Jun 1969. 13p. Dep. CFSTI (U. S. Sales Only). AECL $0.50.

Continuous solvent extraction was evaluated as a preconcentration technique for sensitivity enhancement of continuous atomic absorption measurements. A simple automated solvent extraction system was developed, which can be quickly attached to any atomic absorption spectrophotometer to give a 100 to 200 fold sensitivity enhancement. (auth)

7395 (HASL–212) SEQUENTIAL DETERMINATION OF STABLE BARIUM, STRONTIUM, CALCIUM, AND MAGNESIUM IN BIOLOGICAL MATERIALS. Sutton, Doris C.; Miro, Milagros (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Jul 1969. 82p. Dep. CFSTI.

Trace amounts of barium were determined serially with strontium, calcium, and magnesium in ashed samples of diet, water, excreta, soft tissue, and bone by atomic absorption spectroscopy after classical chemical separations and anion exchange chromatography. The alkaline earths were separated from silica and the alkali metals after dehydration and phosphate collection, respectively. Barium, strontium, and calcium were separated from magnesium, the transition metals, and phosphate by nitrate precipitation. Barium was separated from strontium and calcium by absorption on Bio-Rad AG-1-X8 (100 to 200 mesh) anion exchange resin conditioned with 10% nitric acid–90% methanol mixed solvent. Strontium and calcium were washed off the resin with the same mixed solvent. Barium was removed from the resin with dilute nitric acid. Barium-133, strontium-85, and beryllium-7 were added to the sample to correct radiometrically for barium, strontium, and magnesium losses during the chemical method. Calcium was measured in two fractions. The radiometric yield of ^{7}Be tracer for magnesium was 100%. The coefficient of variation for magnesium and calcium results ranged between 0.5 and 4.0%. The radiometric yields for ^{133}Ba and ^{85}Sr ranged between 85 to 95 and 75 to 99%, respectively, and the coefficients of variation varied from 1 to 10%. Two figures are given; one shows sensitivity differences for barium using two flames and different burner heads, the other is an illustration of calcium interference in barium absorption with the nitrous oxide-acetylene flame. Two tables show, respectively, the operational conditions and instrumental setttings for the measurement of the four elements, and the effect of various ions common to biological materials on barium absorption with the nitrous oxide-acetylene flame. The analytical concentrations of the four elements in biological materials are given in twelve tables. Results are compared with that of other workers using different methods of analysis, such as, emission spectrography, flame photometry, and neutron activation. Appended are computer programs to calculate the atomic absorption sample results with illustrations of the output data. (auth)

7396 (IEA–165) SPECTROPHOTOGRAPHIC DETERMINATION OF BORON IN URANIUM, ALUMINUM, AND MAGNESIUM: EXTRACTION OF TETRAFLUOROBORATE WITH MONOMETHYLTHIONINE. Federgruen, Ludmila; Abrao, Alcidio (Instituto de Energia Atomica, Sao Paulo (Brazil)). Jun 1968. 20p. (In Portuguese). (CONF-670737–2). Dep. CFSTI (U. S. Sales Only).

From 19th Annual Meeting of Brazilian Society for the Progress of Science, Rio de Janeiro, Brazil.

The determination of microquantities of boron in highly pure uranium compounds is done through solvent extraction of the BF_4 ion complexed with monomethylthionine (MMT) in 1,2-dichlorethane. Uranium oxide or ammonium diuranate fired to U_3O are dissolved with sulfuric acid, and after addition of hydrofluoric acid the blue BF_4^-–MMT complex is extracted in dichlorethane and measured at 640 to 645 mu in 1.0 cm cell. The lowest boron concentration measured in the organic phase was 0.02 ppM. Boron was determined in the 0.2 to 10.0 microgram range, and for the determination of 0.1 ppM B in uranium the maximum error was ±15%. (auth)

7397 (LA–4260) COMBUSTION-MANOMETRIC METHOD FOR SIMULTANEOUS DETERMINATION OF CARBON AND HYDROGEN. MacDougall, Carolyn S.; Smith, Maynard E.; Waterbury, Glenn R. (Los Alamos Scientific Lab., N. Mex.). 12 Sep 1969. Contract W-7405-eng-36. 7p. Dep. CFSTI.

A combustion-manometric method was used to determine small amounts of carbon and hydrogen in various materials. The sample is burned at 1000°C in a fused-silica furnace containing Alundum chips and cupric oxide to support the sample and ensure complete oxidation. The water formed from the hydrogen in the sample is collected in a trap cooled by an ethanol–dry ice mixture, and then measured manometrically at 100°C. The carbon dioxide produced from the carbon in the sample passes through the first trap, is collected in a second capillary trap cooled by liquid nitrogen, and is measured manometrically at room temperature. Several materials, including tantalum, plutonium, and (uranium, plutonium) dioxide, were analyzed for carbon and hydrogen in this manner. For 100-mg samples, the standard deviations are ±5 ppM in determining 5 to 50 ppM carbon and 10 relative % at higher concentrations. For the determination of hydrogen in 100-mg samples, relative standard deviations are 1 to 2% above 11 ppM, 5% at the 11-ppM level, and 60% at the 5-ppM concentration level. This method applies equally well to any material that oxidizes completely at 1000°C in the presence of oxygen, but does not form volatile products other than carbon dioxide and water. (auth)

7398 (NIM–460) A RAPID METHOD FOR THE DETERMINATION OF MINOR AMOUNTS OF THORIUM IN AQUEOUS SOLUTIONS OF URANYL NITRATE OR CHLORIDE. Laboratory Method No. 90/11. Cook, E. B. T.; Steele, T. W. (National Inst. for Metallurgy, Johannesburg (South Africa)). 31 Jan 1969. 4p. Dep. CFSTI (U. S. Sales Only).

Thorium is determined spectrophotometrically with Arsenazo III. Uranium and other interfering elements are separated from the Th by use of an anion exchange resin in the chloride form. The method is suitable for the determination of ThO_2 in solutions from 1 ppM upwards, and can be completed within 1 hr. (P.C.H.)

7399 (NIM–470) RAPID ESTIMATION OF URANIUM IN RAFFINATE SOLUTIONS CONTAINING THORIUM BY THE PYRIDYLAZO–NAPHTHOL METHOD. Cook, E. B. T.; Steele, T. W. (National Inst. for Metallurgy, Johannesburg (South Africa)). 10 Feb 1969. 4p. Dep. CFSTI (U. S. Sales Only).

The uranium is extracted into TBP–chloroform solvent, and a red-colored complex is formed by the addition of 1-(2-pyridylazo)-2-naphthol to the solvent. The color is then compared with a set of standards that were treated in a similar manner. The method is applicable to solutions of as low a concentration of uranium as 0.05 g/l, and of as high a concentration of thorium and nitric acid as 60 g/l and 160 g/l, respectively. (D.H.M.)

7400 (SC-RR-69-784) ATOMIC ABSORPTION MICRO-SAMPLING OF LEAD, CADMIUM, INDIUM, AND THALLIUM IN URINE. Torres, Frank (Sandia Labs., Albuquerque, N. Mex.). Dec 1969. 22p. Dep. CFSTI.

Urine samples and standard spiked urine samples are made alkaline to a pH of 8. Dithizone in methyl isobutyl ketone (MIBK) is added to the samples and shaken to extract the metals. The MIBK layer is separated from the urine layer, centrifuged, and the emulsion-precipitate is separated from the liquid layers. The precipitate is either brought to a volume of 5 milliliters (ml) with water and mixed well or dissolved in dilute acid. The solution is placed in a sampling boat, where it is dried, and the concentration of the metal is determined by the "sampling boat" technique. The detection limits vary for each metal, but are improved over aspiration methods. (auth)

7401 (UCRL-18972) PHOTOELECTRON SPECTROSCOPY: A CHEMICAL TOOL FROM NUCLEAR SPECTROSCOPY. Hollander, Jack M. (California Univ., Berkeley. Lawrence Radiation Lab.). Aug 1969. Contract W-7405-eng-48. 41p. (CONF-690818-8). Dep. CFSTI.

From International Conference on Radioactivity in Nuclear Spectroscopy, Nashville, Tenn.

The development of photoelectron spectroscopy and some of its applications are reviewed. Solid or gaseous samples are exposed to a flux of x rays of known energy and the photoelectrons expelled are energy analyzed in the spectrometer. Examples of application of the method are given. (M.C.G.)

7402 MASSENSPEKTROMETRISCHE ISOTOPENANALYSE. (Mass Spectrometric Isotope Analysis). Birkenfeld, Heinz; Haase, Gunther; Zahn, Hans. Physikalisch-Chemische Trenn- und Messmethoden. Band 5. Berlin; Veb Deutscher Verlag der Wissenschaften (1969). 323p. M 54.-.

Topics covered include: mass and abundance of isotopes, principles of mass spectrometers, ion sources, ion current indicators, registering the mass spectra, analytical methods, sources of errors, and isotopic analysis of elements, inorganic compounds, molecular hydrogen, and organic compounds. (M.C.G.)

7403 THE USE OF OXAZINES IN ANALYSIS. PART II. THE SPECTROPHOTOMETRIC DETERMINATION OF IODIDE AND BROMIDE WITH NILE BLUE. Likussar, W.; Pokorny, G.; Zechmann, H. (Univ., Graz). Anal. Chim. Acta; 49: 97-102 (Jan 1970). (In German).

The determination of micro amounts of iodide or bromide with the oxazine dyestuff Nile Blue is described. The salt of the dye is extracted into chloroform and measured spectrophotometrically at 626 nm. Beer's law is obeyed over the range 0.5 to 3 ppM for iodide and 1 to 6 ppM for bromide. The methods are evaluated statistically and the effects of diverse ions are described. (auth)

7404 ANODIC VOLTAMMETRIC DETERMINATION OF PLUTONIUM. DIFFUSION COEFFICIENTS OF PLUTONIUM(III) IN MINERAL ACIDS. Plock, C. E. (Dow Chemical Co., Golden, Colo.). Contract AT(29-1)-1106. Anal. Chim. Acta; 49: 83-7 (Jan 1970).

Plutonium(III) can be determined at the glassy carbon electrode by anodic voltammetry in the concentration range $2.24 \cdot 10^{-4}$ to $4.48 \cdot 10^{-3}$ M in 0.5 M perchloric acid. Any oxidizing substance and iron(II) interfere. Hydrochloric, nitric, and sulfuric acids also interfere at various concentrations. Diffusion coefficients were determined in 0.5 M perchloric, hydrochloric, nitric, and sulfuric acids. (auth)

7405 ANALYTICAL CHEMISTRY OF THE NOBLE METALS. Beamish, F. E. International Series of Monographs in Analytical Chemistry. Volume 24. New York; Pergamon Press (1966). 620p.

Seven chapters are included; a separate abstracts was prepared for each. 868 references are appended. (P.C.H.)

For abstracts of individual chapters see: 7406–7410, 7492, and 8066.

7406 GRAVIMETRIC METHODS FOR THE SEVEN NOBLE METALS. pp 249-323 of Analytical Chemistry of the Noble Metals. /Beamish, F. E. New York; Pergamon Press (1966).

Various reagents and methods are described for the gravimetric determination of each of the noble metals. (P.C.H.)

7407 VOLUMETRIC METHODS. pp 324-62 of Analytical Chemistry of the Noble Metals. /Beamish, F. E. New York; Pergamon Press (1966).

Reagents and methods are described for the volumetric determination of each of the noble metals. (P.C.H.)

7408 SPECTROPHOTOMETRIC METHODS. pp 363-486 of Analytical Chemistry of the Noble Metals. /Beamish, F. E. New York; Pergamon Press (1966).

Reagents and methods are described for the spectrophotometric determination of each of the noble metals. (P.C.H.)

7409 SPECTROCHEMICAL ANALYSIS OF THE PLATINUM METALS. Lewis, Clyde L. (Falconbridge Nickel Mines Ltd., Thornhill, Ont.). pp 487-539 of Analytical Chemistry of the Noble Metals. /Beamish, F. E. New York; Pergamon Press (1966).

Discussion is presented on: the determination of low or trace concentrations of Pt metals; determination of trace impurities in refined Pt metals; determination of intermediate or high concentrations of platinum metals in alloys or mixtures of Pt metals or other materials; and newer physical methods for trace element determination. Problems related to these types of analyses are considered, and the development of spectrochemical methods is outlined. (P.C.H.)

7410 EQUIPMENT. pp 540-73 of Analytical Chemistry of the Noble Metals. /Beamish, F. E. New York; Pergamon Press (1966).

Equipment used for various procedures mentioned throughout the book are described and illustrated. Page number references to the procedures are given. (P.C.H.)

7411 THE SPECTROPHOTOMETRIC DETERMINATION OF BERYLLIUM WITH ERIOCHROME BRILLIANT VIOLET B. Uesugi, Katsuya (Himeji Inst. of Tech., Japan). Anal. Chim. Acta; 49: 89-95(Jan 1970).

Beryllium can be determined spectrophotometrically with eriochrome brilliant violet B (C.I. 43570). The complex shows maximum absorbance at pH 5.8 to 7.0; Beer's law is obeyed over the range 0.02 to 0.15 ppM of beryllium at 560 nm. The molar absorptivity in 59500 and the sensitivity is 0.0002 μg of beryllium per cm^2, corresponding to $\log I_0/I = 0.001$. The mole ratio of beryllium and eriochrome brilliant violet B in the complex is estimated to be 1:2. Copper(II), cadmium, nickel, aluminum, iron(III), chromium(III), yttrium, scandium, and the rare earth elements interfere seriously; a method of separation is described. (auth)

7412 SPECTROSCOPIC PROPERTIES OF INORGANIC AND ORGANOMETALLIC COMPOUNDS. VOLUME II. REVIEW OF THE LITERATURE PUBLISHED DURING 1968. Greenwood, N. N. London; The Chemical Society (1969). 546p. 100s.

The literature on nuclear magnetic resonance spectroscopy, nuclear quadrupole resonance spectra, electron spin resonance spectroscopy, microwave spectroscopy, vibrational spectra, electronic spectra, and Moessbauer spectroscopy is reviewed. Extensive bibliographies are included. (UK)

Isotopic Procedures

7413 DETERMINATION OF NIOBIUM IN ROCKS BY AN ISOTOPE DILUTION: SPECTROPHOTOMETRIC METHOD. Greenland, L. Paul; Campbell, E. Y. (Geological Survey, Washington, D. C.). Anal. Chim. Acta; 49: 109-14(Jan 1970).

Rocks and minerals are fused with sodium peroxide in the presence of carrier-free ^{95}Nb. The fusion cake is leached with water and the precipitate dissolved in hydrofluoric–sulfuric acid mixture. Niobium is extracted into methyl isobutyl ketone and further purified by ion exchange. The amount of niobium is determined spectrophotometrically with 4-(2-pyridylazo)-resorcinol, and the chemical yield of the separations determined by counting ^{95}Nb. This procedure is faster and less sensitive to interferences than previously proposed methods for determining niobium in rocks. The high purity of the separated niobium makes the method applicable to nearly all matrices. (auth)

Radiometric Procedures

7414 (N-69-37225) A SIMPLE METHOD FOR DETERMINATION OF FISSION GASES TRAPPED IN IRRADIATED FUEL FORMS. Sheibley, Dean W. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Oct 1969. 9p. (NASA-TM-X-1893). CFSTI.

A simple, rapid, safe, quantitative method for determining fis-

sion gases trapped in Mo–UO_2 and W–UO_2 cermets is described. The method uses electrolytic dissolution of the cladding and matrix, and acid dissolution of the fuel. The gaseous activity is collected in charcoal collection vials at liquid-nitrogen temperature. Recovery is greater than 99 percent. Fission gas activity is determined by gamma counting the gas-collection vials. The explosion hazard due to the electrolytic production of hydrogen and oxygen is eliminated. The accuracy of the method is ±2.5 percent (standard deviation) at 10^8 disintegrations per minute. (STAR) (auth)

7415 (RFP–1401) EIGHT UNIT ISOTHERMAL CALORIMETER FOR ROUTINE PLUTONIUM ANALYSES. White, Robert G.; Oetting, Franklin L. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 14 Nov 1969. Contract AT(29-1)-1106. 9p. Dep. CFSTI.

The design and operation of a multi-unit isothermal calorimeter, whose primary function is to analyze for plutonium, is described. Although each individual unit is similar in design to the corresponding unit in the twin isothermal calorimeter, the overall design and operation of the multi-unit calorimeter is unique. (auth)

7416 RAPID ASSAY OF ENVIRONMENTAL RADIOACTIVE CONTAMINATION WITH SPECIAL REFERENCE TO A NEW METHOD OF WET ASHING. Sansoni, B.; Kracke, W.; Winkler, R. (Gesellschaft fuer Strahlenforschung mbH, Neuherberg, Ger.). pp 487-500 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB–226; CONF-690317.

Rapid methods for environmental radioactive monitoring are required for emergency situations and extreme low activities with measuring times that would otherwise be too long. Special operations are necessary for extreme low γ activities and especially for identification and determination of α and β contamination in environmental samples. Of the different chemical operations very often ashing of organic material is the most timeconsuming operation. For these reasons a method was developed for wet ashing of food and biological material by OH radicals from H_2O_2/Fe^{2+} (Fenton's reagent) in aqueous solution. Advantages are the large samples that can be ashed per run, the mild conditions, little control, and low loss of trace elements or radionuclides. Disadvantages are the resistance of fat, oil, charcoal, or plastics and the addition of iron. The method was used with good results for rapid assay of extreme low activities of ^{137}Cs by rapid dissolution, separation on the ion exchanger $K_2[FeCo(CN)_6]$, and gamma spectrometry in the NaI well, ^{137}Cs by β measurement after separation on $(NH_4)_2[FeCO(CN)_6]$, and gross α and β activity in lettuce. (auth)

7417 RADIOSTRONTIUM IN BIOLOGICAL MATERIAL: A PRECIPITATION AND EXTRACTION PROCEDURE ELIMINATING THE USE OF FUMING NITRIC ACID. Fourie, H. O.; Ghijsels, J. P. (Atomic Energy Board, Pelindaba, S. Afr.). Health Phys.; 17: 685-9(1969).

A method avoiding the use of fuming nitric acid in the determination of radiostrontium in biological material is discussed and described. A phosphate precipitation with bismuth is followed by the isolation of calcium and strontium as carbonate. A single treatment of the carbonate with 70% nitric acid to isolate strontium is carried out and the chemical yield determined as the sulphate. The contribution of strontium-90 is obtained by the solvent extraction of the daughter product yttrium-90. Overall recoveries of 90% are obtained. The whole procedure is considerably faster and more convenient than the current fuming nitric acid method. (auth) (UK)

Activation Procedures

Refer also to abstract 7781.

7418 (ORNL-tr-2265) ACTIVATION ANALYSIS WITH CHARGED PARTICLES AND GAMMA PHOTONS. Engelmann, Ch. Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.), from Bull. Inform. Sci. Tech. (Paris); No. 140, 65-70(1969). 7p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 24: 2162.

7419 CHERENKOV COUNTING OF AQUEOUS SOLUTIONS IN ACTIVATION ANALYSIS. Girardi, F.; Camera, V.; Sabbioni, E. (EURATOM-Joint Nuclear Research Centre, Ispra, Italy). Radiochem. Radioanal. Lett.; 2: 195-202(20 Dec 1969).

Cherenkov counting of aqueous solutions has interesting applications in activation analysis. A few results obtained in the study of of its applicability to routine radioassay in activation analysis are summarized. (auth)

7420 CLINICAL APPLICATION OF ACTIVATION ANALYSIS. Comar, D. (Frederic Joliot Hospital, Orsay, France). Advan. Activ. Anal.; 1: 163-206(1969).

It is stated that for a large proportion of the elements in the periodic table activation analysis is among the most sensitive available analytical techniques, and is the ideal method for studying the concentration of these elements in the normal tissues and for investigating changes in their metabolism associated with pathological conditions. Furthermore, activation analysis avoids reagent contamination of samples, since reagents are not used until after the sample has been activated and nonradioactive contaminants cannot interfere with the assay of induced activity in the elements being determined. Activation analysis is particularly useful for metabolic studies with an element which has a stable isotope of low natural abundance, capable of substantial enrichment; with such materials it is possible to measure the concentration in the body as a function of time after injection. The possibility of making nondestructive analyses is also an important aspect of activation analysis in relation to clinical science, together with estimation of certain elements in vivo. The subject is discussed under the following headings: techniques in activation analysis of biological material (samples; irradiation; chemical treatment; measurement of radioactivity); metabolic and kinetic studies (the relevance of trace element measurements; stable tracers); activation analysis in vivo (general considerations; whole body activation in vivo; localized activation in vivo). 116 references. (UK)

7421 RAPID DETERMINATION OF THORIUM IN URINE BY THERMAL NEUTRON ACTIVATION ANALYSIS. Twitty, Bryce L.; Boback, Michael W. (National Lead Co. of Ohio, Cincinnati). Anal. Chim. Acta; 49: 19-24(Jan 1970).

The determination of subnanogram quantities of thorium in human urine is described. A urine sample is split into two aliquots, one of which is spiked with a known concentration of thorium; the aliquots are processed simultaneously. Simple pre- and post-irradiation separations are used to minimize ^{24}Na and ^{38}Cl Compton interferences, after 15-min activations at about 10^{12} n cm^{-2} sec^{-1}. ^{233}Th is counted as quickly as possible after irradiation. The sensitivity of the method is 10^{-10} g Th/l, and processing requires only 45 min. A urine sample from a thorium worker averaged $6.02 \cdot 10^{-8}$ g Th/l. A composite sample from four unexposed persons averaged $0.13 \cdot 10^{-8}$ g Th/l. Other samples from unexposed persons contained 0.16, 0.25, and $0.43(\cdot 10^{-8})$ g Th/l. (auth)

7422 RARE EARTH ELEMENT DISTRIBUTION IN ANORTHOSITES AND ASSOCIATED HIGH GRADE METAMORPHIC ROCKS, LOFOTEN-VESTERAALEN, NORWAY. Green, T. H.; Brunfelt, A. O.; Heier, K. S. (Mineralogisk-Geologisk Museum, Oslo). Earth Planet. Sci. Lett.; 7: 93-8(Nov 1969).

La, Ce, Nd, Sm, Eu, Gd, Tb, Yb, and Lu were determined by neutron activation analysis in 3 anorthosites, 5 granulite facies rocks (including 3 mangerites areally associated with the anorthosites) and 2 amphibolite facies gneisses from the Lofoten–Vesteraalen Precambrian province, Norway. The REE distribution in each case is a linear, fractionated pattern relative to chondrites. The anorthosites show a marked Eu anomaly, and the overall REE content is less than the other rocks. The mangerites show no depletion in Eu, and may only be cogenetic with the anorthosite if the volume ratio mangerite/anorthosite is greater than one-half. No fractionation of light REE relative to heavy REE was observed in rocks of similar major element chemistry with change in metamorphic grade from amphibolite to granulite facies. Also no change in overall REE content with this increase in metamorphic grade was detected. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 7404, 7445, 7450, 7463, 7491, 8061, 8117, 8165, 8186, and 8873.

7423 (COO–294-9) PARAMAGNETIC RESONANCE ABSORPTION. Technical Progress Report. Hutchison, Clyde A. Jr. (Chicago Univ., Ill. Dept. of Chemistry). 4 Dec 1969. Contract AT(11-1)-294. 13p. Dep. CFSTI.

All the magnetic resonance spectrometers were reconstructed. Experimental data were obtained on the superhyperfine interactions between $^{147}Sm^{3+}$ or $^{149}Sm^{3+}$ and Cl^- ions in $LaCl_3$ single crystals. Very good single crystals of NpF_6 in UF_6 at a concentration of a few mole percent were prepared. Studies were undertaken of the

photoexcited states of Nd^{3+}, Er^{3+}, and some other rare earth ions in several different crystals. By means of a bimodal cavity microwave power was pumped into one of the hyperfine lines of the EPR absorption of $^{235}U^{3+}$ in $LaCl_3$ while observing the EPR absorption of a second hyperfine line. The EPR spectra of photoexcited anthracene was studied. EPR and ENDOR experiments were also carried out on benzene. The ENDOR spectrum of phenanthrene photoexcited molecules was obtained. The intermediate neglect of differential overlap (INDO) calculations were made on diphenylmethylene. Theoretical studies were carried out on proton hyperfine interactions in triplet state organic molecules at zero magnetic field and at very low magnetic fields. EPR studies are being made on the kinetics of chemical reactions. (M.C.G.)

7424 (COO-1149-157) LOW TEMPERATURE CHEMICAL THERMODYNAMICS PROJECT. Technical Progress Report No. 17, November 1968-November 1969. (Michigan Univ., Ann Arbor. Dept. of Chemistry). 1 Nov 1969. Contract AT(11-1)-1149. 49p. Dep. CFSTI.

Several actinide and lanthanide compounds and other materials of nuclear relevance were prepared and various thermodynamic properties have been or are being studied. The enthalpy of combustion and the derived enthalpy of formation for triptycene were determined by rotating oxygen bomb calorimetry and preliminary calculations made for estimation of strain energy. Values were compared with those calculated for bicyclo [2.2.2] octane and bicyclo [2.2.2] octene. Similar studies were carried out on paracyclophane. Investigations on the thermodynamic properties of bicyclic globular molecules were continued. An attempt was made to correlate data on the transition and fusion of globular molecules of bicyclo [2.2.2] heptane, -octane, and -nonane. Heat capacity measurements were conducted on $FeMoO_4$ and $FeWO_4$ from 5 to 350°K. (J.G.B.)

7425 (COO-1780-4) STABLE ISOTOPE TRACER STUDIES. Progress Report, March 1, 1969-February 28, 1970. Gordon, Gilbert (Iowa Univ., Iowa City. Dept. of Chemistry). 21 Nov 1969. Contract AT(11-1)-1780. 11p. Dep. CFSTI.

Studies were made of the effect of "bridging ligands" on the chromium(II)-uranyl ion reaction. ^{18}O tracer experiments indicated very efficient transfer of oxygen from the uranyl ion to the chromium(III) product. The labilizing effect of ligands bound in cis and trans position on the reactions of chromium complexes are being studied. Studies of the reduction of chlorine-containing oxidizing agents by metal ions showed the existence of ClO_2 as an intermediate and first reduction product. Results strongly suggested that the rate of reduction of the chlorine oxidants is governed by the structural properties of the metal ion complex. Studies are also being made on the effect of scavengers on the removal of intermediates in reactions that involve the reduction of various chlorine-containing oxidizing agents. A double-tagged tracer study was made of the decomposition of uranyl peroxide dihydrate. (auth)

7426 (UCRL-18951) CRYSTALLOGRAPHY AND THERMOCHEMISTRY OF SOME CHLOROCOMPLEX COMPOUNDS OF THE LANTHANIDE AND ACTINIDE ELEMENTS. Morss, Lester Robert (California Univ., Berkeley. Lawrence Radiation Lab.). Aug 1969. Contract W-7405-eng-48. 262p. Dep. CFSTI.

Thesis.

Several complex compounds containing lanthanide and actinide (III) or (IV) ions in sixfold chloride coordination were prepared in amounts ranging from several grams to one microgram. Preparative techniques for compounds Cs_2NaMCl_6 (M = trivalent cation) and Cs_2MCl_6 (M = tetravalent lanthanide or actinide cation) are discussed. Structures of these compounds were studied by the x-ray powder method. All compounds Cs_2NaMCl_6 that were prepared are face-centered cubic; the lattice parameter of $Cs_2NaBkCl_6$ is 10.805(3) Å. The synthesis and chemical analysis of a new compound of Bk(IV), Cs_2BkCl_6, are described; this compound is hexagonal, with a = 7.450(3), c = 12.098(5) Å. (Error limits represent 95% confidence.) The principles of design and the experimental operation of some solution microcalorimeters are described. The most versatile microcalorimeter has a capacity of 30 ml, a thermal leakage modulus of 0.0009^{min-1}, and a sensitivity of 2×10^{-4} cal. Heats of solution of standard substances, of lanthanide and actinide metals, and of compounds Cs_2NaMCl_6, are reported. The crystallographic and thermochemical measurements on chlorocomplex compounds were combined with auxiliary data to yield heats of formation of lanthanide and actinide chlorides, chlorocomplex compounds, and ions; redox potentials for lanthanide and actinide species; ionization potentials for several lanthanide and actinide ions; hydration energies for lanthanide and actinide(II) and (III) ions; and a set of ionic radii based upon sixfold chloride coordination. Comparative stabilities and crystal structures of chlorocomplex compounds are discussed and systematized. (auth)

7427 PRECIPITATION OF PLUTONIUM(IV) MOLYBDATE. Watanabe, Kenju; Muromura, Tadasumi (Japan Atomic Energy Research Inst., Ibaraki). Nippon Kagaku Zasshi; 90: 1025-7 (Oct 1969). (In Japanese).

The precipitation of plutonium(IV) molybdates in acidic solutions was studied. Plutonium(IV) molybdates were precipitated by adding a solution of Pu(IV) to sodium molybdate in 0.1 ~ 0.3 N HCl or in acetic acid-sodium acetate buffer solutions of pH 1.5 ~ 4.1. The composition of the precipitate was dependent on pH of the solution, concentration of sodium molybdate in the solution, and contact time of the precipitate with the mother liquor. The solubility of the precipitate corresponding to the normal molybdate, $Pu(MoO_4)_2 \cdot n\,H_2O$, was $(0.9 \sim 7.5) \times 10^{-4}$ mole/l in 0.16 ~ 1.0 N HCl at 25°C. The precipitate was decomposed at 750 ~ 1150°C to PuO_2 and volatile MoO_3. (auth)

7428 HYDROGEN-DEUTERIUM EXCHANGE OF SEVERAL OPTICALLY ACTIVE COMPLEXES OF COBALT(III) IN D_2O SOLUTIONS. Yamatera, Hideo; Fujita, Miho (Nagoya Univ., Japan). Bull. Chem. Soc. Jap.; 42: 3043(Oct 1969).

The rates of deuterium exchange were measured for several optically active cationic cobalt complexes dissolved in D_2O containing an optically active anionic species. In the case in which the solution contained no tartrate, but instead an acetate buffer, the rates of hydrogen exchange were very similar. In the presence of d-tartrate, however, the rate constants were appreciably smaller for $d[Co(en)_3]^{3+}$ than for the l-isomer. This seems to imply that there is some stereoselective interaction in the solution between the isomers of $[Co(en)_3]^{3+}$ and the d-tartrate ion. Similar results were obtained for d- and l-$[Co(NO_2)_2(en)_2]^+$ in the presence of l-$[Co(EDTA)]^-$. (P.C.H.)

7429 STEREOCHEMISTRY OF ASYMMETRIC SILICON. XV. STEREOSPECIFIC HYDROSILATION AND EXCHANGE REACTIONS OF $R_2Si^*H(D)$ CATALYZED BY GROUP VIII METAL CENTERS. Sommer, L. H.; Lyons, J. E.; Fujimoto, H. (Univ. of California, Davis). J. Amer. Chem. Soc.; 91: 7051-61(3 Dec 1969).

The addition of R_3Si^*H to olefins (hydrosilation) catalyzed by transition metal centers proceeds with retention of configuration as do Si^*H-Si^*D isotopic exchange reactions. The data are accommodated by the general mechanistic conclusion that the initial process in these reactions involves stereospecific retentive interaction of the Si*-H bond with the reactive transition metal center to form a metal-silicon bond which then reacts in a variety of ways with complete retention of configuration in hydrosilation and isotopic exchange reactions. (auth)

7430 FAR-INFRARED AND RAMAN SPECTRA OF PHOSPHONIUM BROMIDE AND PHOSPHONIUM BROMIDE-d_4. Durig, J. R.; Antion, D. J.; Pate, C. B. (Univ. of South Carolina, Columbia). J. Chem. Phys.; 51: 4449-56(15 Nov 1969).

The infrared spectra of thin films of PH_4Br and PD_4Br have been recorded from 33 to 4000 cm^{-1} at -170°C. Raman spectra of polycrystalline samples were also recorded at -170°C. Three librations and two translations have been assigned for both compounds, and eight internal fundamentals were observed. Other bands found in the infrared and Raman spectra were attributed to overtones and combinations involving external and internal fundamentals. Static field and correlation field splittings of 25 and 11 cm^{-1}, respectively, were observed for PH_4Br. The barriers restricting phosphonium ion rotation in the respective lattices were calculated from the observed liberational frequencies and the barrier height for the PH_4 ion is 7.8 kcal/mole (v = 354 cm^{-1}) and for the PD_4 ion is 7.9 kcal/mole (v = 254 cm^{-1}). (auth)

7431 PULSE RADIOLYSIS OF ALIPHATIC ACIDS IN AQUEOUS SOLUTIONS. II. HYDROXY AND POLYCARBOXYLIC ACIDS. Simic, M.; Neta, P.; Hayon, E. (Army Natick Labs., Mass.). J. Phys. Chem.; 73: 4214-19(Dec 1969).

Pulse radiolysis of aqueous solutions of aliphatic hydroxycarboxylic acids (glycolic, lactic, tartaric, and citric) leads to the formation of hydroxycarboxyalkyl radicals. Similarly, polycarboxyalkyl radicals are formed from polycarboxylic acids (malonic, succinic, and tricarballylic). These radicals are formed as a result of hydrogen abstraction by OH radicals and H atoms and have characteristic transient absorption spectra dependent on pH. This dependence is attributed to the sequential dissociation of the carboxyl and α-hydroxyl groups. The pK values for the carboxyl group in the hydroxycarboxyalkyl radicals are higher than those of the parent acids and are close to the pK values of the nonsubstituted acids and their radicals, inferring a diminution of the inductive effect of the OH group on the radical. The pK values for the dissociation of the OH group in an α position to the unpaired electron in hydroxycarboxyalkyl radicals are lower than those of the corresponding α-hydroxyalkyl radicals. The second-order decay rates of the various carboxyalkyl radicals were found

to be strongly dependent on the number of charges on the radicals. (auth)

7432 X-RAY DIFFRACTION STUDIES OF MONO- AND POLYNUCLEAR THORIUM(IV) IONS IN AQUEOUS PERCHLORATE SOLUTIONS. Bacon, W. E.; Brown, Glenn H. (Kent State Univ., Ohio). J. Phys. Chem.; 73: 4163-6(Dec 1969).

X-ray diffraction study of aqueous solutions of thorium(IV) oxyperchlorate has established the presence of polynuclear species containing clusters of four thorium atoms. The thorium–thorium distance is 4.00 Å. Thorium(IV) perchlorate in acid media is found to contain mononuclear species. The thorium(IV) has a coordination number of 11 in both thorium(IV) oxyperchlorate and thorium(IV) perchlorate solutions. (auth)

7433 A HYDROGEN ISOTOPE EFFECT IN $CuSO_4.5H_2O$. Heinzinger, Karl (Max-Planck-Institut fuer Chemie, Mainz). Z. Naturforsch.; 24a: 1502-11(Oct 1969). (In German).

There are two kinds of water in $CuSO_4 \cdot 5\ H_2O$ differing by their binding in the crystal. The oxygen of four water molecules is bonded to the copper ion, that of the fifth molecule is hydrogen bonded. It is shown that the D/H ratios of these two kinds of water differ by 5.7%, the light isotope being enriched in the water molecules coordinated with the copper ion. The results show that there is no exchange of the hydrogen isotopes during the time needed for dehydration at room temperature which takes several days. The assumption was confirmed that the water coordinated with the copper ion leaves the crystal first on dehydration at temperatures below 50°C. Additional measurements of the separation factor for the hydrogen isotopes between water vapor and copper sulfate solutions allow conclusions on the fractionation of the hydrogen isotopes between bulk water and hydration water in aqueous solutions. (auth)

7434 ISOTOPE EXCHANGE INVESTIGATIONS ON SILICATE ION EXCHANGERS. VIII. INTERPRETATION OF THE NON-UNIFORM SELF-DIFFUSION OF ALKALI METAL IONS IN SYNTHETIC ZEOLITE A. Gaus, H.; Hoinkis, E. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Z. Naturforsch.; 24a: 1511-17(Oct 1969). (In German).

The kinetics of Na^+ isotopic exchange in zeolite A was measured at 21°C. The exchange rate does not fit the classical function for the time-dependence of an ideal diffusion process. This confirms what was observed earlier for the isotopic exchange of Rb and Cs ions. It is assumed that, on the average, the more strongly bound cations start diffusing later than the other cations. Further it is assumed that the distribution over the different lattice sites is temperature dependent. The solution of the appropriate diffusion equation yields the diffusion constant D along with the fraction of stronger bound cations and the probability b (sec^{-1}) of escape of these cations from their lattice sites. In the case of the Cs^+ isotopic exchange the agreement between calculated and measured exchange curves is excellent. The results of this investigation show that the method of isotopic exchange between solid and solution as carefully investigated by Zimen can be used to determine the distribution of exchangeable cations over different sites. (auth)

7435 ISOTOPIC EXCHANGE INVESTIGATIONS ON SILICATE ION EXCHANGES. IX. SELF-DIFFUSION OF Sr IONS IN SYNTHETIC ZEOLITE A. Hoinkis, E.; Levi, H. W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Z. Naturforsch.; 24a: 1672-3 (Oct 1969). (In German).

Measurements were made of Sr isotopic exchange in Zeolite A and diffusion processes were studied. The temperature dependence of Sr self-diffusion coefficients in Zeolite A was determined. (M.C.G.)

7436 A STUDY OF EQUILIBRIUM ISOTOPE EFFECTS OF TERTIARY AMINES BY NMR AND POTENTIOMETRY. Leyden, Donald E.; McCall, J. M. (Univ. of Georgia, Athens). Anal. Chim. Acta; 49: 77-81(Jan 1970).

A comparative study of solvent isotope effects on the dissociation constant of amine salts, by means of potentiometric and nuclear magnetic resonance techniques was performed. Agreement of the results of the two techniques was generally good. The magnetic resonance technique offers an advantage in cases in which the amine is insoluble in neutral or basic solutions. An observed correlation between the isotopic shift of N-methyl proton chemical shift and the spin coupling between the methyl protons and the N–H proton is mentioned. (auth)

7437 ADVANCES IN INORGANIC CHEMISTRY AND RADIOCHEMISTRY. VOLUME 10. Emeleus, H. J.; Sharpe, A. G. (eds.). New York; Academic Press Inc. (1967). 476p. $18.00.

Separate abstracts were prepared for two sections; the remaining section concerns the halides of boron. (D.H.M.)

For abstracts of individual sections see: 7439 and 7440.

7438 ENERGY DISPOSAL IN THE HOT HYDROGEN ATOM ISOTOPE EXCHANGE REACTION (H,HD). White, John M. (Univ. of Texas, Austin). Chem. Phys. Lett.; 4: 441-3(15 Dec 1969).

Data are presented which demonstrate that the hot hydrogen atom isotope exchange reaction $H + HD \rightarrow H_2 + D$ furnishes a deuterium atom which is not. (auth)

7439 FURTHER ADVANCES IN THE STUDY OF MECHANISMS OF REDOX REACTIONS. Sykes, A. G. (Univ. of Leeds, Eng.). Advan. Inorg. Chem. Radiochem.; 10: 153-245(1967).

A review concerned with reactions of metal ions in which the oxidation state of the metal ions changes as a result of the reactions is presented that includes one-equivalent exchange reactions; two-equivalent exchange reactions; reactions in which binuclear complexes are formed; other one-equivalent reactions between metal ions; noncomplementary and two-equivalent reactions; outer-sphere reactions and theoretical considerations; reactions of the solvated electron with metal ions; and reactions of metal ions with compounds of nonmetallic elements. (425 references) (D.H.M.)

7440 MIXED VALENCE CHEMISTRY: A SURVEY AND CLASSIFICATION. Robin, Melvin B. (Bell Telephone Labs., Inc., Murray Hill, N. J.); Day, Peter. Advan. Inorg. Chem. Radiochem.; 10: 247-422(1967).

A review is presented concerning inorganic compounds that contain ions of the same element in two different formal states of oxidation. The theory of mixed valence effects is discussed and the following elements are considered: Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zr and Hf, Nb and Ta, Mo and W, Tc and Re, Ru and Os, Rh and Ir, Pd and Pt, Ag, Au, Ga, In, Tl, Sn, Pb, P and As, Sb, Bi, lanthanides, and actinides. (820 references) (D.H.M.)

7441 ON THE SOLID STATE REACTION BETWEEN URANIUM OXIDE (U_3O_8) AND MAGNESIUM OXIDE (MgO). PART II. COMPOSITIONS OTHER THAN U_3O_8–3MgO. Amato, I.; Negro, A. (Polytechnico, Turin). J. Less-Common Metals; 20: 37-48(Jan 1970).

The solid state reaction between U_3O_8 and MgO was studied for compositions other than U_3O_8–3MgO in order to examine the influence of an excess of U_3O_8 or MgO in the formation of $MgUO_4$. When excess U_3O_8 is present the $MgUO_4$ formed dissolves in the U_3O_8 lattice; when excess MgO is present the reduction of $MgUO_4$ at high temperature is diminished and during cooling a new body-centered cubic phase having the composition $MgUO_{3.8}$ and a true density of 9.2 g/cm^3, is formed. The MgU_3O_{10} decomposes at 1200°C into $MgUO_4$ and U_3O_8. (auth)

Radiation and Nuclear Chemistry

Refer also to abstracts 7589, 7950, 8213, and 8530.

7442 (AAEC/TM–503) A SURVEY OF RADIATION INDUCED GRAFT POLYMERISATION TO CELLULOSE. Moore, P. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1969. 42p. Dep. CFSTI (U. S. Sales Only).

The literature on radioinduced graft polymerization of monomers to cellulose is reviewed. Radioinduced grafting to cellulose textiles is commonly achieved either by prolonged immersion of the pre-irradiated cellulose substrate in a monomer solution, or by irradiating the cellulose while it is immersed in a monomer solution. Electron irradiation can be used in the former method, and less homopolymer is formed, particularly when oxygen is excluded during both the irradiation and grafting steps. With the second method, higher degrees of grafting are obtained at lower irradiation doses. The optimum experimental conditions are unique for each cellulose–monomer system. Since the various parameters such as pretreatment, water content, solvent, monomer concentration, irradiation dose, irradiation dose rate, temperature, and atmosphere are often interdependent, some apparently contradictory results have been reported. A tabulated guide is included to assist in the selection of the most suitable grafting conditions for a variety of cellulose and monomer types. Although mechanisms of the grafting reactions are not considered in any detail, other relevant aspects of graft polymerization reactions, and the physical and chemical nature of cellulose graft copolymers, are discussed. The disruption of the natural cellulose structure by excessive grafting is discussed, and is related to the effects on the physical properties of the grafted product. Although there is no direct evidence of a chemical link between the cellulose and the side chains, a large amount of indirect evidence has been accumulated. (101 references) (auth)

7443 (ORO–3909-1) SYNTHESIS, IDENTIFICATION, AND PURIFICATION OF C_6 AND C_7 FLUOROCARBONS FROM RA-

DIOLYSIS. Annual Progress Report. Askew, W. C.; Ward, C. H.; Wright, J. R.; Carey, G. W. (Auburn Univ., Ala. Dept. of Chemical Engineering). Nov 1969. Contract AT(40-1)-3909. 20p. Dep. CFSTI.

Gas chromatographic methods for analyzing perfluoroalkanes were developed. Purification techniques for purifying perfluoroalkane isomers were developed and normal perfluorohexane was purified from a mixture of perfluorohexane isomers. Samples of C_2F_8, C_3F_8, and $n\text{-}C_4F_{10}$ with and without carbon granules were irradiated by ^{60}Co gamma rays. (auth)

7444 (RFP-1404) MODIFIED FORTRAN IV PROGRAM FOR GAS PHASE RADIOLYSIS DATA REDUCTION. Werkema, George J. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 24 Oct 1969. Contract AT(29-1)-1106. 12p. Dep. CFSTI.

This program is a modification of one written earlier (USAEC Report RFP-624, Rocky Flats Division, The Dow Chemical Co., November 1965) for a small computer. The availability of a computer having a medium-to-large memory permits various improvements to be made in operating convenience. The present version, RADF-2, is written in E-level FORTRAN IV for the IBM 360/40G computer. The RADF-2 program converts analytical data obtained at several times during a gas phase radiolysis experiment into the molar and molecular quantities, which may be plotted or further reduced to "G" values. The computed results are output in tabular form for each gas, along with the computed radiation dose, as a function of time. (auth)

7445 (RLO-2014-9) RADIATION CHEMISTRY, PHOTOCHEMISTRY AND EXCITED STATES OF a) OXYANIONS AND b) DNA. Comprehensive Report, January 1, 1967-October 1969. Daniels, Malcolm (Oregon State Univ., Corvallis). Contract AT(45-1)-2014. 19p. Dep. CFSTI.

Investigations of the radiolysis of concentrated aqueous solutions are reported under the following headings: γ radiolysis of concentrated aqueous $NaNO_2$ solutions; pulse radiolysis of concentrated nitrate solutions; uv photolysis of nitrate solutions; and γ radiolysis of $LiNO_3$, KNO_3, $CsNO_3$, and $Ca(NO_3)_2$. Studies on the radiation chemistry and photochemistry of DNA are reported. Flash photolysis of halogen-substituted and methyl-substituted uracils and of thymine is discussed. (M.C.G.)

7446 (STI/DOC-10/84) RADIATION CHEMISTRY AND ITS APPLICATIONS. Technical Reports Series No. 84. Report of a Panel Held in Vienna, 17-21 April 1967. (International Atomic Energy Agency, Vienna (Austria)). Apr 1968. 182p. (In English and French). (CONF-670411). Dep. IAEA $4.00.

Discussions, general observations, and recommendations are summarized and 10 reports presented. Separate abstracts were prepared for the reports. (M.C.G.)

For abstracts of individual papers see: 7471-7480.

7447 (TID-25265) RADIATION-INITIATED EMULSION OXIDATION. Final Report, May 1, 1968-June 30, 1969. Van Sickle, Dale E.; Castleman, Jane K.; Hendry, Dale G.; Gould, Constance W. (Stanford Research Inst., Menlo Park, Calif.). Contract AT(04-3)-115. 34p. Dep. CFSTI.

Investigations were made of emulsion polymerization and oxidation where ionizing radiation was used to initiate the free radicals. The effects of oxygen on the radioinduced emulsion polymerization of styrene were studied. The oxygen strongly inhibited the rate of monomer consumption. For most substrates oxidized in water emulsion, the rate was nearly independent of the emulsifying agent used. (M.C.G.)

7448 RADICAL CONVERSIONS IN γ-IRRADIATED 3-METHYLPENTANE-ISOBUTENE SYSTEMS. Tsuji, Kozo; Okamura, Seizo (Kyoto Univ.). Bull. Chem. Soc. Jap.; 42: 2827-30(Oct 1969).

Radical conversions in γ-irradiated 3-methylpentane-isobutene systems were observed by means of the electron spin resonance method after keeping the sample at -196°C for a few days, or by subjecting it to ultraviolet irradiation. One of the changes was caused by hydrogen atom abstraction from neighboring molecules by original free radicals. The other change was attributed to dissociation of the free radicals from 3-methylpentane by uv irradiation. (auth)

7449 FURTHER RESULTS ON THE ISOMERIC EFFECT IN SZILARD-CHALMERS RECOIL OF ^{60m}Co AND ^{60g}Co IN Co(III) COMPLEXES IN RELATION TO THE STORAGE TEMPERATURE. Lazzarini, E. (Politecnico, Milan). Energ. Nucl. (Milan); 16: 654-61(Oct 1969).

Previously it was reported that the ratio ρ of the retentions of ^{60m}Co and ^{60g}Co atoms produced by neutron capture in Co(III) complexes is linearly correlated with the splitting Δ of 3d-orbitals of Co(III) induced by the ligand field. In these experiments the neutron irradiation time was 5 minutes and the separation of recoiled ^{60m}Co and ^{60g}Co atoms from the target started within 50 to 60 seconds after the end of the irradiation. Successively the dependence of slope b of the correlation line between ρ and Δ was studied in function of the storage time, before the separation, and of the storage temperature. It was found that slope b increases with the storage time, at the storage temperature of -74°C and +16°C, while b decreases sharply at the storage temperature of +64°C. Finally ρ and Δ are no longer correlated after 30 min of storage at +135°C. In order to obtain further information on the dependence of b on the storage temperature, experiments were subsequently carried out at the following storage temperatures: -186, +39, and +77°C. The results obtained complete and confirm previous findings that the storage temperature, at constant storage time, has a small effect on slope b of the correlation line between ρ and Δ up to a temperature of about 20°C. Above this temperature b decreases sharply so that ρ and Δ can no longer be considered correlated at temperatures of about 90 to 100°C. The results are discussed in terms of a possible mechanism leading to the isomeric effect. (auth)

7450 STABILISATION OF ELECTRONS IN ALKALINE γ-IRRADIATED LIGHT AND HEAVY ICE AT 77°K. Kroh, J.; Stradowski, Cz.; Mayer, J. (Inst. of Radiation Chemistry, Lodz, Poland). Radiochem. Radioanal. Lett.; 2: 209-16(20 Dec 1969).

Isothermal decay of trapped electrons e_s^- in frozen matrices: $NaOH/H_2O$, $NaOD/D_2O$, and $NaOH/H_2O + D_2O$ was investigated. Decay kinetics at 180°K and 175°K is complex and can be represented by two linear fragments in a half-logarithmic plot. The kinetic isotope effect ranges between 2.0 and 6.9 being considerably increased with decreasing temperature. Decay kinetics and isotope effects are ascribed respectively to a) inhomogeneous distribution of e_s^- formed in two processes, $e_i^- \rightarrow e_s^-$ and $H + OH^- \rightleftharpoons e_s^-$, b) differences in stabilizing properties of the matrices. (auth)

7451 IRRADIATION POPCORN POLYMERS. Breitenbach, J. W. (Univ. Vienna); Sulek, H.; Charlesby, A.; Fydelor, P. J. J. Polymer. Sci., Part A-1; 7: 3257-9(Nov 1969).

Results are reported on the radiation stability of popcorn polymers that show a remarkable difference between the behavior of seed material and material proliferated in a monovinyl compound. Gamma irradiation produced no visible change of the micro-optical anisotropy of nonproliferated polymers. When proliferated popcorn polymers samples were irradiated, the specimens in the dry state maintained their micro-optical anisotrophy, but in contact with benzene they swelled, became optically isotropic, and then dissolved, either partially or completely, depending on the sample and irradiation dose. It was concluded that crosslinks responsible for the limited swelling of proliferated popcorn polymers do not have the same stability against irradiation as the divinylbenzene crosslinks in the nonproliferated materials. (D.H.M.)

7452 OPTICAL AND ESR STUDIES ON TRIPHENYLIMIDAZOLYL RADICALS PRODUCED BY PHOTOLYSIS AND RADIOLYSIS AT LOW TEMPERATURE. Shida, Tadamasa (Inst. of Physical and Chemical Research, Saitama, Japan); Maeda, Koko; Hayashi, Taro. Bull. Chem. Soc. Jap.; 42: 3044(Oct 1969).

It was previously reported (T. Hayashi and K. Maeda, Bull. of Chem. Soc. Japan, 40: p. 2990 (1967)) that uv illumination of the photochromic dimer of triphenylimidazolyl (photodimer, abbreviated as R_2) at -196°C induced a coloration which was attributed to the formation of a radical cation of the dimer. It is now reported that the coloration should be associated with the formation of triphenylimidazolyl radical R·, as in the case of photolysis of the dimer at room temperature. Similar results with methyltetrahydrofuran were obtained with both uv photolysis and γ radiolysis. Reasons for the results are discussed. (P.C.H.)

7453 ELECTRON ATTACHMENT BY PYRIDINE AND THE DIAZINES IN γ RADIOLYSIS. EXPERIMENTAL AND THEORETICAL CONSIDERATION. Grimison, A.; Simpson, G. A.; Sanchez, M. Trujillo; Jhaveri, J. (Univ. of Puerto Rico, San Juan). Contract AT(40-1)-1833. J. Phys. Chem.; 73: 4064-70(Dec 1969).

Absorption spectra characterizing the radical anions of pyridine, pyrimidine, pyrazine, and pyridazine were produced by γ radiolysis of the parent compounds in a 2-methyltetrahydrofuran matrix at 77°K. These spectra are in good agreement with those obtained by chemical reduction or electrolysis, but some additional transitions at longer wavelengths were observed. Pariser-Parr-Pople calculations of the theoretical doublet-doublet transitions of the radical anions yield good correlations with the experimental transitions. The best correlation is obtained by not including configuration interaction, at least for a very limited number of configurations. (auth)

7454 FREE RADICAL FORMATION IN HYDROCARBON CRYSTALS BY γ IRRADIATION. ELECTRON SPIN RESONANCE SPECTRA OF SOME ALKYL RADICALS. Gillbro, Thomas (Aktiebolaget Atomenergi, Studsvik, Sweden); Kinell, Per-Olof; Lund, Anders. J. Phys. Chem.; 73: 4167-74(Dec 1969).

Single crystals and polycrystalline samples of the n-alkanes, pentane, hexane, heptane, nonane, decane, and undecane, were prepared by a freezing technique. The crystals were irradiated at 77°K with ^{60}Co γ rays to a dose of 3 Mrads. Electron spin resonance in the X band and Q band demonstrated that $CH_3-CH-CH_2-R$ is the predominant radical species in all hydrocarbons except for undecane. The measured coupling constants found are the isotropic $a_1 = 25 \pm 1$ G (quartet), $a_2 = 33 \pm 1$ G (triplet), and the orientation dependent doublet splitting $a_3 = 12.5 - 33$ G. A complexity in the central region of the spectrum from undecane is thought to indicate the presence of additional alkyl radicals. Cleavage of the carbon chain is improbable. An irreversible decrease in line width with temperature was explained in terms of a disappearance of the dipolar interaction between radicals some 30 Å apart. In single crystals indications of radical pair formation were found. (auth)

7455 ELECTRON SPIN RESONANCE STUDIES OF IRRADIATED HETEROGENEOUS SYSTEMS. V. NAPHTHALENE, ANTHRACENE, PHENANTHRENE, AND BIPHENYL ADSORBED ON POROUS SILICA GEL. Kinell, Per-Olof; Lund, Anders; Shimizu, Akira (Swedish Research Council's Lab., Studsvik). J. Phys. Chem.; 73: 4175-82(Dec 1969).

Naphthalene, anthracene, phenanthrene, and biphenyl adsorbed on silica gel were irradiated with ^{60}Co γ rays at a dose rate of 200 krads/hr to a total dose of 3 Mrads. The amount of adsorbed material was 0.1 to 1%. Aromatic cations were detected by their ESR spectra at 77 to 300°K. The singly charged naphthalene dimer and biphenyl monomer were unambiguously identified. The coupling constants of the naphthalene cation are similar to the solution values. The splittings of the biphenyl cation are $a_{para} = 6.6$ G, $a_{ortho} = 2.8$ G. Neutral radicals formed seem to react at higher temperatures to yield secondary radicals which are persistent above room temperature. (auth)

7456 PULSE-RADIOLYSIS STUDIES OF p-HYDROXYPHENYLPROPIONIC ACID. Chrysochoos, J. (Univ. of Toledo). J. Phys. Chem.; 73: 4188-93(Dec 1969).

The pulse radiolysis technique was used to investigate the initial radiolysis products of aqueous p-hydroxyphenylpropionic acid (S). The transient absorption spectra show that OH and H adducts are formed initially in acidic and near-neutral solutions while in alkaline solutions both addition products and phenoxyl radicals are formed simultaneously. The decay of the addition products in acidic and near-neutral solutions is accompanied by a parallel formation of phenoxyl radicals by a process obeying first-order kinetics with $k = (2.7 \pm 0.3) \times 10^4$ sec^{-1}. Both the OH and H adducts have overlapping intense uv absorptions. Their molar extinction coefficients at 320 and 330 mμ are 5.0×10^3, 3.5×10^3 and 3.4×10^3, 4.1×10^3 M^{-1} cm^{-1}, respectively. The reaction rate constants of H atoms with p-hydroxyphenylpropionic acid is $(1.5 \pm 0.3) \times 10^9$ M^{-1} sec^{-1}. Evidence was obtained for reactions of O_2 with the phenoxyl type radicals in alkaline solutions of p-hydroxyphenylpropionic acid and L(−)-tyrosine, and with the OH adduct of DL-phenylalanine. (auth)

7457 PULSE RADIOLYSIS OF ALIPHATIC ACIDS IN AQUEOUS SOLUTIONS. I. SIMPLE MONOCARBOXYLIC ACIDS. Neta, P.; Simic, M.; Hayon, E. (Army Natick Labs., Mass.). J. Phys. Chem.; 73: 4207-13(Dec 1969).

Transient optical absorption spectra due to carboxyalkyl radicals were observed on pulse radiolysis of aqueous solutions of some aliphatic acids (formic, acetic, propionic, n- and isobutyric, and trimethylacetic acids). These radicals were produced as a result of dehydrogenation by H atoms and OH radicals at the α and/or β positions. The assignment of these radicals was supported by the results obtained from the reaction of e_{aq}^- with the corresponding monochloroaliphatic acids when dechlorination takes place. The α-carboxyalkyl radicals (C_2-C_4) studied have absorption maxima in the region 290 to 350 nm, while the β radicals (C_3-C_5) have maxima below 250 nm. The observed change with pH in the transient absorption spectra of these radicals was attributed to the dissociation of the carboxyl group. The pK values of these radicals were determined spectrophotometrically and were found to correspond in most cases to the pK values of the parent aliphatic acids. The extinction coefficients and decay rates were also found to be dependent upon pH. The reactivity of $\cdot CH_2OH$, $CH_3\dot{C}HOH$, $\cdot CH_2C(CH_3)_2OH$, $\cdot CH_2COO^-$, and $\cdot CO_2^-$ radicals with $\cdot CO_2^-$ and $\cdot CH_2COO^-$ was investigated. (auth)

7458 THE EFFECT OF CHARGE SCAVENGERS ON RADIATION-INDUCED ISOMERIZATION OF STILBENE IN CYCLOHEXANE. Hentz, Robert R.; Lehmann, H. P. (Univ. of Notre Dame, Ind.). J. Phys. Chem.; 73: 4283-9(Dec 1969). (COO-38-679).

Effects of electron scavengers (benzyl acetate, $C_6H_5NO_2$, N_2O, CH_3Cl, and CO_2) and cation scavengers (NH_3 and piperidine) on radiation-induced isomerization of trans-stilbene in cyclohexane were studied; all but CO_2 suppress $G_{t\to c}$. Effects of the electron scavengers are discussed in relation to empirical equations for quantitative description of the nonhomogeneous kinetics of charge scavenging in γ-irradiated liquid alkanes. Results are consistent with a model in which isomerization is initiated by electron capture by stilbene with subsequent isomerization via stilbene excited states formed in neutralization of stilbene anions by cyclohexane and stilbene cations. The observed absence of any effect of CO_2 on $G_{t\to c}$ is attributed to stilbene excitation in reaction of CO_2^- with a stilbene cation. Study of the radiation-induced isomerization of cis-stilbene is affected by the extreme sensitivity of cis-stilbene isomerization to sample-preparation procedures. Though very large values previously reported for $G_{c\to t}$ in benzene could not be reproduced, present results in both benzene and cyclohexane confirm an appreciable catalytic contribution; in cyclohexane, $G_{c\to t} = 7.4$ for 0.2 M cis-stilbene, and $G_{c\to t}/G_{t\to c}$ exceeds the corresponding quantum-yield ratio by more than a factor of 4 for 0.1 M stilbene. Participation of ionic processes in the catalytic contribution is indicated by suppression of $G_{c\to t}$ by various charge scavengers. A pronounced catalytic effect is observed with C_2H_5Br and SF_6 (probably via Br and an SF_x radical from neutralization of the anions formed by electron capture); e.g., $G_{c\to t} \approx 5500$ for 0.01 M C_2H_5Br and 0.2 M cis-stilbene in cyclohexane. (auth)

7459 EXTINCTION COEFFICIENT OF AZULENE ANION RADICAL AND THE YIELD OF SCAVENGEABLE ELECTRON IN γ-IRRADIATED ORGANIC GLASS. Shida, Tadamasa (Inst. of Physical and Chemical Research, Saitama, Japan). J. Phys. Chem.; 73: 4311-14(Dec 1969).

γ Irradiation of azulene in 2-methyltetrahydrofuran at 77°K produces azulene anion radicals that exhibit an absorption band at 440 mμ. The increase of the anion band is in proportion to the decrease of azulene band at 687 mμ. Knowing the extinction coefficient of the 687-mμ band at 77°K as 168.3 l mol^{-1} cm^{-1}, the extinction coefficient of the anion band was determined to be 6.78×10^3 l mol^{-1} cm^{-1}. The G value of total scavengeable electron for the matrix was determined as 2.53 on the basis that all scavengeable electrons react with azulene to form its anion. (auth)

7460 COMPETITIVE REACTIONS OF RECOIL TRITIUM ATOMS WITH METHYSILANES AND ALKANES. Daniel, S. H.; Tang, Yi-noo (Texas A and M Univ., College Station). J. Phys. Chem.; 73: 4378-81(Dec 1969).

Studies of recoil tritium reactions with tetra-, tri-, and dimethylsilanes in one-component systems, as well as in two-component mixtures with their corresponding member of the alkane series, make possible the evaluation of the silicon-skeletal and carbon-skeletal compounds. The primary reactions of recoil tritium atoms with methylsilanes are the abstraction of the substitution for hydrogens, and the reaction at the Si−C bond to give either CH_3T or a formation of the corresponding Si−T bond. Comparison of the reactivities of alkylsilanes and their corresponding hydrocarbons shows that the total reactivities of $(CH_3)_4Si$ and $(CH_3)_4C$ are approximately the same; however, for the other two pairs, the data show that $(CH_3)_3SiH$ and $(CH_3)_2SiH_2$ are, respectively, about 20 and 50% more reactive than their hydrocarbon counterparts. Data reveal that the total reactivities at the Si−C bonds are always higher than those at the corresponding C−C bonds. (D.H.M.)

7461 DEUTERIUM SULFIDE AS AN ELECTRON SCAVENGER IN THE RADIOLYSIS OF LIQUID SATURATED HYDROCARBONS. Holland, P. T.; Stone, J. A. (Queen's Univ., Kingston, Ont.). J. Phys. Chem.; 73: 4397-8(Dec 1969).

The γ radiolysis of saturated hydrocarbons (hexane and cyclohexane) in the liquid phase with varying concentrations of D_2S as solute was studied. G-values of D_2, HD, H_2, and N_2 are given for the radiolysis of liquid n-hexane containing N_2O and D_2S at 298°K. $G(N_2)$ is reduced with increasing D_2S concentration but the $G(H_2 + HD + D_2 + N_2)$ remains constant. It was concluded that although it was shown that electron capture by D_2S occurs it cannot be said whether positive charge scavenging occurs at the same time. (D.H.M.)

7462 THE CHEMISTRY OF NUCLEAR RECOIL ^{18}F ATOMS. II. ENERGETIC F-FOR-F AND RING-ATTACK REACTIONS IN PERFLUOROCYCLANES. McKnight, Charles F.; Root, John W. (Univ. of California, Davis). J. Phys. Chem.; 73: 4430-1(Dec 1969).

The ^{18}F recoil chemistry of perfluorocyclanes was studied in an attempt to provide corroborative evidence about the energetics for $^{18}F^* + RF \xrightarrow{F\text{-for-}F} R^{18}F + {}^{19}F$ as well as characterizations for the hot ^{18}F abstractions $^{18}F^* + RF \xrightarrow{F\text{-to-}F_3} {}^{18}F + \cdot R$ and ring-attack $^{18}F^* + c\text{-}C_xF_{2x} \rightarrow n\text{-}C_xF_{2x}{}^{18}F$ reactions. The inorganic ^{18}F was measured through successive treatment of samples with granulated Cu metal (for $F\,{}^{18}F$) and anhydrous K_2CO_3 (for $H\,{}^{18}F$), followed by NaI(Tl) scintillation detection of the ^{18}F annihilation photopeak. From results it was concluded that recoil ^{18}F reacts preferentially with the carbon–carbon bonds in perfluorocyclanes by at least a factor of 2 on a per-bond basis [(C–C):(C–F) > (93/4):(100/8)]. (D.H.M.)

7463 KINETICS OF HYDROGEN ISOTOPE EXCHANGE REACTIONS. PART XVII. COMPETITION BETWEEN MESITYLENE AND BENZENE IN AROMATIC EXCHANGE UNDER THE INFLUENCE OF β-RADIATION. Adsetts, J. R.; Gold, V. (King's Coll., London). J. Chem. Soc., B; No. 9, 1114-17(1969).

The radioinduced tritium uptake by mesitylene was inhibited by the addition of benzene. This inhibition was quantitatively accounted for by tritium exchange in benzene, which competes with mesitylene for the tritiating species. The total reactivity ratio mesitylene:benzene (referring to the sum of all reactions by which the tritiating species can be scavenged by these compounds) was 9; the exchange reactivity ratio (which applies only to the processes leading to tritiated mesitylene and benzene) was 8.5 ± 0.5. The enhancement of the reactivity by methyl substituents supported the formulation of the reaction mechanism in terms of radiolytically produced tritium atoms, and the agreement between the two estimates was found to point to the relative unimportance of scavenging reactions by these aromatic molecules other than by a process which results in tritium exchange. On this basis the amount of tritium exchange in mesitylene was found to agree with the yield of tritium atoms calculated from the known internal radiation dose to which the solutions were exposed, provided an isotope effect of ca. 10 to 20 (discriminating against the formation of tritium atoms relative to protium atoms) is assumed. (auth) (UK)

7464 IRRADIATED POLYETHYLENE. IV. FREE RADICAL DECAY. Auerbach, Irving; Sanders, Louis H. (Sandia Labs., Albuquerque, N. Mex.). Polymer; 10: 579-96(Aug 1969).

Free radical decay was measured in linear polyethylene over the temperature range of 50 to 125°C. The radicals were formed by β and γ irradiation and their concentrations determined by ESR techniques. Decay rates were measured in nitrogen, air, oxygen, and vacuum environments. The decay reaction which takes place by radical recombination can be resolved into two parts, one more rapid than the other. The rapid reaction takes place in an amorphous region or in a metastable crystalline region which is formed during irradiation; the latter region can become amorphous following a melting–solidification excursion and is, therefore, latently amorphous. The kinetics for the rapid reaction are second order, but tend towards first order as the dose and temperature are increased. The decay-rate constant values are dependent on the total radical concentration and the amount of metastable material. The slow decay reaction takes place in the crystalline region. Its rate-constant values can be related to vinyl-group decay and to the metastable material content. The effects of dose and temperature on the activation energies indicate that these energies can also be correlated with the metastable material. Variations in reaction order for the rapid decay reaction are accounted for with the aid of relationships in which the second-order decay constant is dependent on the decay time and the diffusion coefficient. (auth) (UK)

7465 REACTIONS OF H_2O_3 IN THE PULSE-IRRADIATED Fe(II)–O_2 SYSTEM. Sehested, Knud (Atomic Energy Commission Research Establishment Risoe, Denmark); Bjergbakke, Erling; Rasmussen, Ole Lang; Fricke, Hugo. J. Chem. Phys.; 51: 3159-66(15 Oct 1969).

G[Fe(III)] is measured in pulse-irradiated O_2-saturated solutions of 20 to 160 μMFe(II), at the pH's 0.46, 1.51, and 2.74 H_2SO_4 and $HClO_4$ and with dose rates between 1 and 8 krad/1 μsec pulse. Based on homogeneous kinetics, the results are interpreted by a system of 18 reactions. The formation of the hydrogen sesquioxide H_2O_3 as an intermediate in the reaction $OH + HO_2 \rightarrow H_2O_3 \rightarrow H_2O + O_2$ is confirmed. In the absence of Fe(II), $G(H_2O_3)$ varies from 2.04 at pH 0.46 to 1.57 at pH 2.74. The rate constant $k[H_2O_3 + Fe(II)] = 6.0 \times 1\ {}^4\underline{M}^{-1} \cdot sec^{-1}$ at the pH's studied. The direct reaction, $OH + HO_2 = H_2O + O_2$, does not take place. In H_2SO_4, at pH 0.46, 151, and 2.74 and in $HClO_4$ and pH 0.46 and 1.51, the complexes of Fe(III) produced by the radiation reach equilibrium before they react with HO_2. However, equilibrium is not reached in $HClO_4$ at pH 2.74, where the effective rate constant $k[(HO_2 + Fe(III)]$ is 6.2 times its value when Fe(III) is in its equilibrium form. This ratio is constant over the dose rate range studied. With dose rates up to 64 krad/1.4 μsec pulse G[Fe(III)] and $G(H_2)$ were measured in the air saturated 1-m$\underline{M}$ $FeSO_4$ dosimeter and G[Fe(III)] in the O_2 saturated 10-m$\underline{M}$ $FeSO_4$ dosimeter, each in 0.4 $\underline{M}$ H_2SO_4. G[Fe(III)]decreases in both dosimeters less rapidly with increasing dose rate than was found by earlier workers. The principal reason for the decrease is the failure of O_2 to scavenge the H atoms at high dose rates. Excellent agreement is obtained between experiment and theory except at high dose rates, where the calculated G[Fe(III)]'s are slightly too high in both dosimeters (auth)

7466 CORRELATION OF RESULTS FROM PULSE RADIOLYSIS AND GAMMA-RADIATION: REPAIR PROCESSES IN A MACROMOLECULE IRRADIATED IN SOLUTION. Armstrong, R. C. (Royal Military Coll. of Science, Shrivenham, Eng.). Int. J. Radiat. Biol.; 16: 197-200(1969).

Protective mechanisms operating against radiation damage of polyethylene oxide (PEO) were investigated by pulse radiolysis. Aqueous solutions of PEO and cysteamine (RSH) were irradiated by ^{60}Co γ radiation (dose-rate 600 krads per hour). It appeared that polymer radicals were protected by repair by H atom transfer and by stabilization repair. Only the former type led to an unchanged polymer molecule. Much smaller quantities of protecting agent were needed for the former mechanism than for competitive scavenging of the radiolytic products of water. Sufficient RSH to give complete repair at 0.5 Mrads only afforded 10% protection by competitive scavenging. (auth) (UK)

7467 γ-RADIOLYSIS OF LIQUID t-BUTYL HYDROPEROXIDE. Verdin, D. (United Kingdom Atomic Energy Authority, Wantage, Eng.). Trans. Faraday Soc.; 65: 2438-52(Sept 1969).

The ^{60}Co γ-radiolysis of liquid t-butyl hydroperoxide gives O_2 as the principal gaseous product together with small amounts of H_2, CH_4, C_2H_6, C_2H_4, $(CH_3)_2C{=}CH_2$, and CO. The liquid products are t-butanol, water, di-t-butyl peroxide, acetone, and traces of t-butyl methyl ether and t-butyl methyl peroxide. A satisfactory material balance was obtained between the disappearance of the hydroperoxide ($G_{-Bu^tOOH} = 33.7$ at 20°C) and the yields of the products detected. G values were measured over a range of radiation doses, dose rates, and temperatures and the influence of radical scavengers was examined. Nitrous oxide and benzene did not cause any changes in the product yields. The results indicate that radiolytic decomposition occurs predominantly in the hydroperoxy group, and they are discussed in terms of a mechanism which leads to a G value of 14.2 for direct radiolysis of the liquid hydroperoxide. (auth)

7468 INVESTIGATIONS OF THE SZILARD–CHALMERS EFFECT IN PHENYLARSENIC COMPOUNDS. INFLUENCE OF THE IRRADIATION CONDITIONS. PART 2. DIPHENYLARSENIC COMPOUNDS. Grossmann, G. (Technische Univ., Dresden). Isotopenpraxis; 5: 283-7(Aug 1969). (In German).

The compounds $Ph_2AsO(OH)$, $(Ph_2As)_2O$, $(Ph_2As)_2$ and Ph_2AsH were irradiated at different neutron fluxes, intensities of gamma-radiation, and temperatures in vacuum or in the presence of air. A thermal treatment (annealing) occurs in many cases. The distribution of radioactive arsenic atoms in products with different numbers of phenyl groups per arsenic atom was determined. The following problems are discussed: activity distribution resulting from primary and secondary effects; change of the diffusion-controlled secondary effects by using oxygen as a radical scavenger; tertiary processes caused by the thermal annealing, and quaternary effects caused by gamma rays. For $Ph_2AsO(OH)$, $(Ph_2As)_2O$, $(PH_2As)_2$, and Ph_2AsH the sum of primary and secondary retention (yield of Ph_2As products) is 3; 6; 5, and 1%, but yield of PhAs products is 15; 19; 17 and 17%, respectively. (auth)

7469 OPTICAL AND ELECTRON SPIN RESONANCE STUDIES ON PHOTOLYZED AND RADIOLYZED TETRAPHENYLHYDRAZINE AND RELATED COMPOUNDS. Shida, Tadamasa; Kira, Akira (Inst. of Physical and Chemical Research, Saitama, Japan). J. Phys. Chem.; 73: 4315-20(Dec 1969).

Ultraviolet and γ irradiation of tetraphenylhydrazine in rigid matrices at 77°K induces the following modes of decomposition, respectively. $(C_6H_5)_2NN(C_6H_5)_2 + h\nu \rightarrow 2(C_6H_5)_2N\cdot$ and $(C_6H_5)_2NN(C_6H_5)_2 + e^- \rightarrow (C_6H_5)_2N\cdot + (C_6H_5)_2N^-$. The radical pair in the photolysis has a spin–spin interaction as manifested by ESR spectra, but it is not responsible for the electronic absorption band in the near-infrared region, contrary to the proposal by Kommandeur, et al. Flash photolysis of tetraphenylhydrazine in benzene solution at room temperature yields the diphenyl nitrogen radical which disappears by second-order kinetics with a rate constant of 2.5×10^7 l. mol^{-1} sec^{-1}. Diphenylhydrazine in γ-irradiated matrices undergoes the dissociative electron attachment $(C_6H_5)_2NNH_2 + e^- \rightarrow (C_6H_5)_2N^- + \cdot NH_2$, while dicarbazyl

captures an electron to form the anion radical. The anion is stable at 77°K but dissociates upon bleaching with visible light into a carbazyl radical and a carbazyl anion. The extinction coefficient at 77°K was estimated for the following intermediate species, $(C_6H_3)_2N\cdot$, $(C_6H_3)_2N^-$, dicarbazyl anion, and carbazyl radical. (auth)

7470 SOME PARTICULARITIES OF RADIOCHEMICAL PEROXIDATIONS. GRAFTING OF ACRYLONITRILE ON POLYPROPYLENE PEROXIDE. Chapiro, Adolphe; Czvikovszky, Tibor (CNRS, Bellevue, France). J. Chim. Phys.; 66: 1502-5(Sep 1969). (In French).

Acrylonitrile was grafted at 80°C on polypropylene films preirradiated in air at various temperatures. The results show that polypropylene undergoes a chain hydroperoxidation when irradiated at temperatures above 0°C. Below this temperature, radicals remain trapped in the polymer and are responsible for grafting. A transition point was detected in the polymer at 0°C. The influence of radiation dose was investigated at 40°C. It was found that the grafting rate is directly proportional to the dose of preirradiation up to 155 kilorads. A saturation effect appears at higher doses. The various results are discussed on the basis of a simple kinetic scheme of chain peroxidation. Previous results which seemed to conflict are explained on the basis of a competition step involving peroxidic radicals. These either combine or propagate the chain abstracting H atoms from the hydrocarbon. (auth)

7471 APPLICATION OF IONIZING RADIATION TO POLYMER CHEMISTRY. Danno, A. (Japan Atomic Energy Research Inst., Takasaki-Shi). pp 23-41 of Radiation Chemistry and Its Application. Vienna; International Atomic Energy Agency (1968).

From IAEA Panel Discussion on Applied Radiation Chemistry, Vienna, Austria. See STI/DOC-10/84; CONF-670411.

Promising fields for radiation chemical processes in polymer chemistry are modification of polymer, radioinduced graft polymerization, radioinduced polymerization, and radiation-synthesis of chemicals. There are many special and difficult problems in the practical application of radiation chemistry. Some technological problems are discussed based on radiation chemical processes now being investigated at the Takasaki Radiation Chemistry Research Establishment. Examples are production of foamed polyethylene, grafting of styrene on to cellulose fiber, polymerization of ethylene in the gas phase, solid-state polymerization of trioxane and radiation-initiated chlorination of hydrocarbons. The following points on technological problems regarding the use of radiation sources are discussed: comparison between radioisotope sources and electron beam accelerators, radioisotope sources used on a large scale, and the dose and dose-rate required for radiation treatment. (auth)

7472 CHARACTERISTICS AND RANGE OF APPLICABILITY OF ACCELERATORS FOR RADIATION CHEMICAL PROCESSES. Holm, N. W. (Research Establishment, Risoe, Denmark). pp 43-51 of Radiation Chemistry and Its Application. Vienna; International Atomic Energy Agency (1968).

From IAEA Panel Discussion on Applied Radiation Chemistry, Vienna, Austria. See STI/DOC-10/84; CONF-670411.

A general description of the characteristics of dc accelerators and linear accelerators is given. Some comments are made on the economics of radiation processing, beam characteristics, penetration characteristics, process control, and conversion efficiency. (auth)

7473 STATUS REPORT ON CHEMONUCLEAR REACTORS AND RADIATION CHEMICAL PROCESSING. Steinberg, M. (Brookhaven National Lab., Upton, N. Y.). pp 53-62 of Radiation Chemistry and Its Application. Vienna; International Atomic Energy Agency (1968).

From IAEA Panel Discussion on Applied Radiation Chemistry, Vienna, Austria. See STI/DOC-10/84; CONF-670411.

The use of nuclear energy for synthesis and production of industrial chemicals is reviewed. Fission-fragment chemonuclear reactors are used for large-capacity basic endothermic reactors. These are applicable to the fixations of nitrogen, synthesis of ozone and synthesis of carbon monoxide from low-cost, readily available, raw materials. The development of fissiochemonuclear fuel elements, fissiochemistry, the contamination problem, in-pile loop experiments, and the economics of chemonuclear reactors are reviewed. The use of isotopic and machine sources is mainly reserved for exothermic chain-type reactions. These sources range from ^{60}Co, ^{137}Cs, ^{90}Sr, to liquid ^{24}Na and In-Ga loops to 0.3- to 20-MeV accelerators. Polymerization, partial oxidation, and halogenation have partially reached commercial status. New areas for research include heterogeneous radiation chemistry, cryogenic radiation chemistry, electrode reactions, plastic material combinations, copolymerization, and ionic polymerization. (auth)

7474 SAFETY FOR LARGE IRRADIATION FACILITIES. Danno, A. (Japan Atomic Energy Research Inst., Takasaki-Shi). pp 63-5 of Radiation Chemistry and Its Application. Vienna; International Atomic Energy Agency (1968).

From IAEA Panel Discussion on Applied Radiation Chemistry, Vienna, Austria. See STI/DOC-10/84; CONF-670411.

Safety for large irradiation facilities on a pilot scale or in industrial use is very important not only from the point of view of radiation, but also from the standpoint of radiation chemical processing. The regulations cover safety for radiation, safety for fire and explosion, safety for high pressure, and safety for corrosion by chemicals. An example is given of the polymerization of ethylene on a pilot scale at the Takasaki Radiation Chemistry Research Establishment. (auth)

7475 LOW-TEMPERATURE IRRADIATIONS. Zagorski, Z. P.; Minc, S. (Inst. of Nuclear Research, Warsaw). pp 67-87 of Radiation Chemistry and Its Application. Vienna; International Atomic Energy Agency (1968).

From IAEA Panel Discussion on Applied Radiation Chemistry, Vienna, Austria. See STI/DOC-10/84; CONF-670411.

The radiation chemistry of deeply frozen materials is reviewed from the point of view of phenomena characteristic of this particular form of radiolysis. Differences of chemical end-points in the liquid and frozen state are stressed. Special attention is paid to the identity and migration of intermediate species at the temperature of irradiation and at higher temperatures (thawing). The importance of luminescent phenomena is shown by examples. Low-temperature radiation chemistry of particular systems (from water to those occurring in outer-space chemistry) is reviewed. In experimental considerations the role of the structure of frozen solids is discussed and the need for additional investigations put forward. (auth)

7476 PULSE RADIOLYSIS. Sangster, D. F. (Australian Atomic Energy Research Establishment, Lucas Heights). pp 89-92 of Radiation Chemistry and Its Application. Vienna; International Atomic Energy Agency (1968).

From IAEA Panel Discussion on Applied Radiation Chemistry, Vienna, Austria. See STI/DOC-10/84; CONF-670411.

The technique of pulse radiolysis makes it possible to examine the early species formed in radiolysis and to study their reactions. There remains much work to be done in the microsecond to millisecond region. Recent advances include techniques with a time resolution of less than one nanosecond. This enables the "primary species" present in the so-called spur region to be studied. These reactions could be important in the concentrated solutions that are likely to be encountered in practical applications. (auth)

7477 DEVELOPMENTS IN RADIOCHEMISTRY: SOME ASPECTS OF THE PRESENT SITUATION. Leveque, P.; Puig, J. R. (Centre d'Etudes Nucleaires de Saclay, France). pp 93-6 of Radiation Chemistry and Its Application. Vienna; International Atomic Energy Agency (1968). (In French).

From IAEA Panel Discussion on Applied Radiation Chemistry, Vienna, Austria. See STI/DOC-10/84; CONF-670411.

The situation in radiochemistry during 1966-67 in France is described. The principal features are the appearance and economic exploitation of powerful irradiation facilities, and the increased emphasis being placed on the industrial nature of development studies. Basic research is being maintained, particularly in macromolecular chemistry. (auth)

7478 SYNTHESIS AND DECOMPOSITION INDUCED BY IONIZING RADIATION. Ionescu, Silvia (Institute of Atomic Physics, Bucharest). pp 97-124 of Radiation Chemistry and Its Application. Vienna; International Atomic Energy Agency (1968).

From IAEA Panel Discussion on Applied Radiation Chemistry, Vienna, Austria. See STI/DOC-10/84; CONF-670411.

Syntheses and decompositions that were studied most are reviewed. Ozone formation and decomposition, hydrazine synthesis from ammonia, nitrogen fixation, hydrocyanic acid formation, radiosynthesis with sulfur, products obtained from the radiolysis of CO_2, products from radiolysis of hydrocarbons, chlorination reactions, radiochemical oxidations, radiolytic carboxidation, ethylene glycol synthesis, and nitration of aromatic compounds are described. The methods employed to increase the G-value of methane transformation in unsaturated hydrocarbons are discussed. (auth)

7479 RADIATION-INDUCED POLYMERIZATION: MECHANISMS AND INDUSTRIAL ASPECTS. Hummel, D. O.; Schneider, Christel; Potter, R. C.; Ley, G.; Denaxas, J.; Widdershoven, D.

(Cologne Univ., W. Ger.); Ryska, M. pp 125-64 of Radiation Chemistry and Its Application. Vienna; International Atomic Energy Agency (1968).

From IAEA Panel Discussion on Applied Radiation Chemistry, Vienna, Austria. See STI/DOC-10/84; CONF-670411.

A current picture is given of radioinduced polymerization in both fundamental and applied research and development. The subjects covered include suspension polymerization, emulsion polymerization, copolymerization, graft copolymerization, ionic polymerization of liquid monomers, and solid-state polymerization. A description is given also of a pilot-plant investigation into certain radiation chemical processes. (auth)

7480 THE USE OF LOW-ENERGY ELECTRON ACCELERATORS FOR THE CURING OF PAINTS AND THIN FILMS. Dalton, F. L. (Atomic Energy Research Establishment, Wantage, Eng.). pp 165-70 of Radiation Chemistry and Its Application. Vienna; International Atomic Energy Agency (1968).

From IAEA Panel Discussion on Applied Radiation Chemistry, Vienna, Austria. See STI/DOC-10/84; CONF-670411.

Considerable industrial interest was aroused in the use of accelerators based on transformer–rectifier sets operating in the 150 to 300 kV range, and in insulating core transformers above 300 kV, for the curing of paint films and the initiation of reactions taking place in thin surface coatings. An indication is given here of the position reached in the commercialization of such processes, and some problems are set out that need to be solved before large-scale exploitation can be achieved. Some general remarks on the advantages of radiation curing and the cost of equipment are also offered. (auth)

7481 IDENTIFICATION OF THE O_3^- RADICAL ION IN X-IRRADIATED $KClO_3$. Schlick, S. (Chemistry Department, Haifa, Israel). Chem. Phys. Lett.; 4: 421-2(15 Dec 1969).

ESR spectra at 77°K of an X-irradiated ^{17}O-enriched $KClO_3$ single crystal show formation of the O_3^- radical ion. At all orientations the radical was trapped at one magnetic site only. Two different ^{17}O hyperfine splittings were observed. Directions and magnitudes of the hyperfine tensor elements allow estimation of the spin density distribution in the singly occupied MO of symmetry b_1. The g-tensor is completely anisotropic. (auth)

7482 ELECTRON SPIN RESONANCE OF HYDROGEN-ADDITION RADICALS IN AN IRRADIATED SINGLE CRYSTAL OF CYTOSINE. Herak, J. N.; Galogaza, V.; Dulcic, A. (Inst. Rudjer Boskovic, Zagreb). Mol. Phys.; 17: 555-7(Nov 1969).

Comments are made on recent ESR studies of free radicals in γ-irradiated single crystals of cytosine monohydrate, both at room temperature and at liquid nitrogen temperature (Cook et al. Molec. Phys. 13: 49; Dextinger Z. Naturf. B, 22: 1266; Herak and Galagaze J. Chem Phys. 50: 3101). A small site splitting was observed but ignored in determination of the principal ESR elements, which introduced some doubt into the conclusion reached. The ESR spectra of irradiated cytoxine was redetermined at room temperature. Considerable differences from the earlier results were obtained. Formation of a radical by addition of H to $C_{(5)}$ was confirmed, and it was shown that there was no significant molecular rearrangement in the irradiated crystals. (UK)

Radiochemistry

Refer also to abstracts 7477 and 7589.

7483 (MLM-1691) ^{238}Pu ISOTOPIC FUEL FORM DATA SHEETS. Smith, W. H.; Rogers, D. R.; Silver, G. L. (Mound Lab., Miamisburg, Ohio). 31 Oct 1969. Contract AT(33-3)-Gen-52. 84p. Dep. CFSTI.

This report supersedes MLM-1564.

A compilation was made of data to September 1, 1969, on isotopic fuel forms of ^{238}Pu. The data are presented under the following headings: metal, PuO_2 microspheres, PuO_2, PuC, PuN, and Pu–Zr alloy. (M.C.G.)

Separation Processes

Refer also to abstracts 7496, 7542, 7589, 7612, 7613, 7621, 8051, 9077, and 9079.

7484 (DP-1213) IODINE RETENTION STUDIES. Progress Report, January–June 1969. Milham, R. C.; Jones, L. R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Nov 1969. Contract AT(07-2)-1. 26p. Dep. CFSTI.

The removal of iodine from activated carbon by flowing air was measured to evaluate various carbons by determining the effects of impurities, service, temperature, loading, and partial regeneration. Carbon service in the confinement system and increased carbon temperature significantly increase desorption of iodine from carbon. Iodine adsorption efficiency decreases slightly with service and with increased loading. Partial regeneration increases iodine adsorption efficiency, but it does not decrease desorption significantly. A treatment was developed to make artificially aged carbon for evaluation of service-related properties. (auth)

7485 (GAMD-9260) HTGR FUEL REPROCESSING: HEAD-END TREATMENT OF EXPERIMENTAL SMALL SCALE HTGR FUEL ELEMENTS. Brooks, L. H. (Gulf General Atomic, Inc., San Diego, Calif.). 9 Sep 1969. Contract AT(04-3)-167. 32p. Dep. CFSTI.

Methods available for debonding TRISO fuel particles from the graphite blocks were reviewed and it was concluded that crushing, sawing and crushing, and whole-block burning are worth further development. In the case of blended BISO fuel particles, the simplest methods are either to cut the block in half and shake the fuel particles out of the holes, or to crush the block and screen the crushed material. It is planned to burn particle-free graphite in a fluidized bed or shaft kiln and the debonded particles (plus a small quantity of graphite) in a fluidized bed. In order to collect design data, a 2-in. fluidized bed was constructed and will soon be operated. Screening the fluid bed solids discharge may be difficult due to wear of the screen caused by sharp alumina particles. Alternatives are alumina spheres or separation by elutriation. Separation of fuel particles by screening is rapid and efficient providing the size gap is greater than 25 μm. (auth)

7486 (ORNL-4414) DISPOSAL OF SOLID WASTE FROM THE REPROCESSING OF NUCLEAR FUELS BY THE FLUIDIZED-BED FLUORIDE-VOLATILITY PROCESS: EVALUATION OF THE CANNING OF WASTE POWDERS. Fitzgerald, C. L.; Shockley, W. E.; Godbee, H. W.; Davis, N. M. (Oak Ridge National Lab., Tenn.). Dec 1969. Contract W-7405-eng-26. 36p. Dep. CFSTI.

The development of methods for disposing of solid wastes that would be generated by the fluidized-bed volatility processing of power reactor fuels was directed, primarily, toward evaluating the problems associated with simply canning (i.e., sealing in a stainless steel pot) the untreated powders. The studies indicated that canning is a suitable method for disposing of these wastes. Simulated waste powders, like the waste powders that would be generated by the $HF-O_2$, HCl, and interhalogen variations in the fluoride-volatility process, were studied by means of gross weight loss and thermal gravimetric techniques. These studies indicated that storage problems could arise at temperatures above 500°C due to the presence of moisture and volatile fluoride compounds. However, it was found that the addition of alkaline earth oxides, such as CaO, could be used to stabilize the powders prior to disposal. Leaching of the powders containing ^{137}Cs tracer resulted in the removal of 80 to 90% of the cesium within one week. In tests with simulated waste powders sealed in nickel and stainless steel containers at 250, 550, and 850°C, the pressure in each container gradually decreased with time. A more pronounced decrease in pressure was observed in a similar test at 850°C in a ^{60}Co irradiation facility. The measured thermal conductivity of an Alcoa T-61 alumina powder was found to be essentially the same as that of a simulated waste powder. Both of these conductivities should be adequate for most proposed waste management systems. Packing characteristics, which have a major effect on thermal conductivity, were determined for each of the waste powders by means of particle-size measurements. (auth)

7487 (ORNL-TM-2728) TRAPPING OF RADIOACTIVE METHYL IODIDE FROM FLOWING STEAM-AIR: WESTINGHOUSE TEST SERIES. Ackley, R. D.; Adams, R. E. (Oak Ridge National Lab., Tenn.). Dec 1969. Contract W-7405-eng-26. 63p. Dep. CFSTI.

The use of iodized charcoal for decontaminating radioactive methyl iodide ($CH_3{}^{131}I$) transported in flowing steam-air was investigated in a series of 18 tests. Approximate conditions for each decontamination test included 130°C (266°F), 55 psia, steam-air face velocity of 40 fpm, 6 mg CH_3I/m^3 (except for two tests with 80 mg/m^3), 1.5 hr CH_3I injection time, and a calculated average relative humidity (R.H.) of 94% or higher. The R.H. value, as used here, is an average value calculated from the experimental conditions relative to the charcoal test bed during CH_3I injection. All 18 tests were on one type of iodized charcoal, MSA 85851 (ORNL No. 021369). The test bed dimensions were 3.5 in. in diameter and 2 in. deep. Two modes of flow, downward and upward, were employed. In tests with ^{131}I-labeled CH_3I at 6 mg/m^3, and with perforated metal used to retain the charcoal, $CH_3{}^{131}I$ decontamination efficiencies (D.E.'s) ranging from 30.7 to 98.6% were observed, depending to a considerable extent on the degree to which the charcoal was wetted with condensed steam. The effect

of gross wetting or flooding of the charcoal and then purging with (approximately) 100% R.H. air on the subsequent D.E., also at 100% R.H., was investigated. With downward flow, D.E.'s of 10 to 19% were obtained; with upward flow, the D.E.'s were 3 to 5%. Results from two other tests using wire screen rather than perforated metal, for purposes of comparison, were not considered conclusive regarding this aspect; the corresponding D.E.'s were, on a comparable basis, somewhat lower, being around 77% for R.H.'s around 99%. In tests with CH_3I at 80 mg/m^3, a slight lowering in $CH_3{}^{131}I$ D.E., relative to tests at 6 mg/m^3, was observed. These results were similar in this respect to those obtained previously for MSA 85851 iodized charcoal at room temperature. (auth)

7488 (RFP-1408) PLUTONIUM ANION EXCHANGE FROM CONCENTRATED SOLUTIONS. Jones, Roy E. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 31 Oct 1969. Contract AT(29-1)-1106. 12p. Dep. CFSTI.

Plutonium purification by anion exchange from nitrate solutions of high plutonium concentration was investigated using 6-inch-diameter by 30-inch-long ion exchange columns. The process was not recommended to replace plutonium purification by hydrogen peroxide precipitation because of relatively poor americium removal and excessive requirements for equipment. (auth)

7489 RADIOCHEMICAL SEPARATIONS BY THE RING-OVEN TECHNIQUE V. SILVER-CADMIUM SEPARATIONS. Klockow, D.; Krivan, V. (Univ., Freiburg i. B.). Radiochem. Radioanal. Lett.; 2: 181-6(20 Dec 1969).

The rapid carrier-free separation of ^{109}Cd and ^{109m}Ag by the ring-oven technique, using carboxymethyl cellulose papers and thiosulfate as complexing agent, is described. The daughter nuclide can be concentrated in the ring zone with ≈90% yield and decontamination factors >10^3. The half-life of the separated ^{109m}Ag was found to be 39.44 ± 0.28 sec. Furthermore, two procedures are described for the carrier-free separation of ^{109}Cd from a silver matrix, using carboxymethyl cellulose and copper sulfide as ion exchangers. With a 0.002 M EDTA solution and 0.25% acetic acid the ^{109}Cd can be washed into the ring zone with satisfactory yield and purity. (auth)

7490 SEPARATION OF RADIOACTIVE WASTE WATER IN THE KRB. Schroeder, H. J. (Kernkraftwerk RWE-Bayernwerk GmbH, Gundremmingen, Ger.). Atomwirt., Atomtech., 14: 363-8(July 1969). (In German).

The radioactive waste water from the KRB nuclear power plant was treated in a processing installation and released into the Danube with satisfactory test results after dilution. The principle, collection of water in different qualities in separate systems and processing it by specific methods, was confirmed. On an average 50% of the water to be processed was recycled. Different official requirements gave impedances and bottlenecks and limited the adaptability of the waste water processing plant. (tr-auth)

7491 THERMAL DIFFUSION IN MOLTEN AND SOLID (bcc) SULFATE MIXTURES, MAINLY ISOTOPE EFFECTS. Lunden, Arnold (Chalmers Univ. of Tech., Goteborg). Z. Naturforsch.; 24a: 1673-4(Oct 1969).

In the molten eutectic $Li_2SO_4-K_2SO_4$, thermal diffusion causes an enrichment of the light cation (Li) as well as of the light isotope of both cations at the hot side. The temperature range was 599 to 853°C. The heat of transport was found to be (273 ± 56) cal/equiv for the separation of Li from K, (36 ± 28) cal/equiv for the Li isotopes, and (43 ± 13) cal/equiv for the K isotopes. The heat of transport for Li isotopes was (161 ± 64) cal/equiv in solid (bcc) $LiNaSO_4$ (at 546 to 588°C) and (316 ± 53) cal/equiv in solid (bcc) $LiAgSO_4$ (at 457 to 547°C). There are indications of a correlation between the heat of transport and the activation energy of self-diffusion. (auth)

7492 METHODS OF SEPARATING THE SEVEN NOBLE METALS. pp 39-248 of Analytical Chemistry of the Noble Metals. /Beamish, F. E. New York; Pergamon Press (1966). DTIE; US

Methods are described for: separation of Os from Ru; separation of Rh from Ir; separation of Au, Pt, and Pd; determination of Os in meteoric Fe; determination of Os and Ru in siderite meteorites and in Fe-Cu-Ni assay buttons; determination of Os and Ru in Pb alloys; determination of noble metals in decorative alloys; determination of Os, Ru, Pd, Pt, Rh, and Ir; determination of noble metals in Ag assay beads; determination of Ir in presence of Pb or Pt; analysis of iridosmines; separation of Pd from Pb alloys; gravimetric determination of Pd in Pb alloys; ion exchange separations; chromatographic separations; wet determination of the six Pt metals in high concentrates; fire assay for noble metals; surface effects of Pt metals in Ag assay beads; slag losses of noble metals; and fire assay procedures. (P.C.H.)

7493 REMOVAL OF RADIOGENIC LEAD FROM POTASSIUM FELDSPARS BY VOLATILIZATION. Sinha, A. K. (Univ. of California, Santa Barbara). Earth Planet. Sci. Lett.; 7: 109-15(Nov 1969).

The isotopic composition of lead was measured in potassium feldspars from granitic rocks and pegmatites having ages of 2720, 1850 and 400 m.y. Isotopic compositions were determined in three fractions for each sample: (a) the bulk material; (b) a fraction of lead, usually about one-third of the total amount, removed by volatilization; (c) the lead remaining in the sample after volatilization. In some cases the isotopic compositions of the lead were nearly identical in all three fractions, while in others, lead was more radiogenic in the volatile fraction and less radiogenic in the residual fraction than in the bulk sample. In most, though not in all cases, the isotopic composition of lead in the homogeneous samples agreed with the isotopic composition of lead in coeval galenas. In samples where radiogenic lead was heterogeneously distributed, the isotopic composition of lead in the residual samples agreed more closely with that in the galenas. In some samples the residual lead had an isotopic composition nearly identical to that of the galenas even though the lead in the bulk sample was more radiogenic. These experiments show that the radiogenic lead in potassium feldspars may be heterogeneously distributed in sites where it is less strongly bound than the remainder of the lead. (auth)

7494 EXTRACTION OF TRACES OF CERIUM, EUROPIUM, TERBIUM, AND LUTETIUM FROM URANIUM(VI) SOLUTIONS WITH DI-2-ETHYLHEXYL PHOSPHORIC ACID. Tomazic, B. (Rudjer Boskovic Inst., Zagreb). Anal. Chim. Acta; 49: 57-65(Jan 1970).

Extraction measurements were performed in order to explain the behavior of rare earth traces on an HDEHP-treated chromatographic column in the presence of milligram quantities of uranium(VI). Under column conditions the rare earth separation factors are lowered, and this impairs the separation. A combined mechanism involving displacement reactions between UO_2^{2+} and RE^{3+}, and degradation of the uranium(VI) polymeric complex is suggested to explain the retarded transfer of a rare earth trace into the aqueous phase. It is shown that at HDEHP : uranium(VI) ratios above 6, the extraction of rare earths is not affected by the presence of uranium(VI), which makes possible the gradual separation of rare earth traces from uranium(VI) solutions. (auth)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 7422, 7486, 7589, 7609, and 8829.

7495 (CEA-R-3684) THE GEOLOGY OF URANIUM IN THE SAINT-SYLVESTRE GRANITE DISTRICT (LIMOUSIN, MASSIF CENTRAL, FRANCE). (Nancy Univ. (France). Centre de Recherches Radiogeologiques. Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jun 1969. 213p. (In French). Dep. CFSTI (U. S. Sales Only).

The geology of uranium in Limousin, more particularly in the St-Sylvestre massif, and the related phenomena is described including regional geology, petrographic and geochemical zonal distribution observed in various granite massifs, uranium movement in connection with surface alteration, and geochronology of uranium ore. (auth)

7496 (DOCKET-50201-27) [WEST VALLEY REPROCESSING PLANT]. [Environmental Monitoring Survey]. ([Nuclear Fuel Services, Inc., West Valley, N. Y.]). [1968]. 112p. Dep. CFSTI.

The environmental monitoring survey at the West Valley Reprocessing Plant included measurements of total α, β, and γ activities in soils, plants, milk, water, and sediments. The ^{90}Sr content in milk and tritium content in water were also measured. Data are given in tables. (M.C.G.)

7497 (MIT-1381-17) VARIATIONS IN ISOTOPIC ABUNDANCES OF STRONTIUM, CALCIUM, AND ARGON AND RELATED TOPICS. Seventeenth Annual Progress Report, 1969. (Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences). 1 Dec 1969. Contract AT(30-1)-1381. 157p. Dep. CFSTI.

Geochronological studies based on measurements of isotropic abundances in metamorphic rocks in northeastern Newfoundland, northern Appalachians, Sierra Leone, and eastern Liberia are presented. Continental accretion in Laurasia based on radiometric ages was investigated. The Rb/Sr ratio age estimations were made for crater rocks of possible impact origin, for whole-rock dating of diabase dikes, and for precambrian iron formations of the Canadian shield. $^{86}Sr/^{87}Sr$ ratios in pyroxene granulites from ten world-wide locations are reported. Techniques and standards for Rb/Sr isotopic determinations are discussed. A bibliography of age data on continental basement rocks is given as well as reprints of miscellaneous papers on geochronology research. Abstracts of five papers in this field presented at international meetings are reprinted. (L.C.L.)

7498 (NP-18085) USE OF LOGGING IN URANIUM PROSPECTING. Hawkins, William K.; Gearhart, Marvin (Gearhart-Owen Industries, Inc., Fort Worth, Tex.). [nd]. 14p.

Wide range gross count gamma probes are now available for recording the count rate of wide grades of uranium ore with other logs being used for specialized study. Properly calibrated systems are being used for gross count quantitative evaluation of the ore bodies. Experimental data available in field spectral logging has helped define the limitations of existing equipment. The use of coaxial type transmission logging cables and field use of new solid state detectors are expected to advance spectral well logging in the future. New and different probe designs are being developed that will help to establish areas that will be more favorable for deposits of uranium ore. (auth)

7499 (NVO-193-7) MODEL TESTS OF GROUTED DEEP-HOLE CASINGS. Final Report. Franz, C. R.; Greimann, L. F. (Southwest Research Inst., San Antonio, Tex.). 24 Jun 1969. 42p. Dep. CFSTI (U. S. Sales Only).

Three models, approximately $^{3}/_{16}$ scale of the prototype casing, were fabricated and tested to study the effects on failure pressures of a grout encasement surrounding deep hole casings. The models were fabricated with materials similar to those used in construction of the prototype. Model No. 1 consisted of a ring-stiffened cylinder, sealed at both ends with closure plates that were attached to a support structure designed to minimize the end loading on the cylinder proper. The model was instrumented and then externally pressurized to a failure pressure of 2300 psi. The results derived from this test served as a basis of comparison with the results obtained when testing two other grout encased models. Model No. 2 was a similarly constructed cylinder encased with a concentric grout sheath. Failure pressure of this model was 2480 psi. The grout encasement on Model No. 3 was poured eccentrically around the ring-stiffened cylinder to simulate a condition where the casing is near the wall of a deviated hole. This model failed at a pressure of 2390. (auth)

7500 (PB-184852) ARL FALLOUT PREDICTION TECHNIQUE. Heffter, Jerome L. (Environmental Science Services Administration, Silver Spring, Md. Air Resources Labs.). May 1969. 48p. (ERLTM-ARL-13). CFSTI.

A manual prediction technique is presented for computing a fallout pattern for a single nuclear surface or air burst. The technique is based on the concept of radioactive particles that fall from a stabilized nuclear cloud, are transported by the winds, and finally deposit over an area on the ground, thus forming a fallout pattern. The computation of a fallout pattern is described in detail. (auth) (USGRDR)

7501 (RLO-1543-6) WATER CONTENT AND SOIL BULK DENSITY MEASURED CONCURRENTLY USING TWO GAMMA PHOTON ENERGIES. Gardner, Walter H.; Campbell, Gaylon S.; Calissendorff, C. (Washington State Univ., Pullman. Dept. of Agronomy). [1969]. 42p. Dep. CFSTI.

Soil bulk density and water content may be obtained concurrently through measurement of the attenuation of gamma photons from two different gamma sources and simultaneous solution of the resulting attenuation equations. Using gamma photons from ^{241}Am at 0.060 MeV and from ^{137}Cs at 0.661 MeV, collimated in a beam 0.045 cm thick and attenuated in 10-cm soil columns, the standard deviation in both water content and bulk density measurements is about 0.007 g/cm^3 for 10^6 counts measured in air and about 0.005 g/cm^3 for 2.5×10^6 counts. Using a 500-mC gamma source and a 6.7 mm^2 collimating slit (ca 75 mC/mm^2) 10^6 counts in air can be obtained in about 1 minute. The random nature of gamma photon emission is the major factor limiting precision for counting periods of a few minutes. However, as greater counts are used the precision of measurement of column thickness and soil and water attenuation coefficients becomes limiting. If, by obtaining extraordinarily large counts, the variance due to random emission is reduced to the same magnitude as that associated with measurement of column thickness or attenuation coefficients precision limit would be about 0.0035 g/cm^3 at mid range values of water content and bulk density. For narrow collimating slits the spatial resolution is only a little greater than slit thickness. Collimator and shielding requirements along with an analyses of errors are given. (auth)

7502 (STI/DOC-10/91) GUIDEBOOK ON NUCLEAR TECHNIQUES IN HYDROLOGY. Technical Reports Series No. 91. (International Atomic Energy Agency, Vienna (Austria)). Sep 1968. 214p. IAEA $5.50.

A guidebook, prepared by the Secretariat of the IAEA, and intended to provide general information on the principles and applications of the nuclear and isotopic methods at present used in hydrological research, is presented. (auth)

7503 (STI/PUB-21/32(Vol.1)) ISOTOPE TECHNIQUES IN HYDROLOGY. VOL. I (1957-1965). Bibliographical Series No. 32. (International Atomic Energy Agency, Vienna (Austria)). Jun 1968. 228p. IAEA $6.00.

This bibliography contains 985 references to the literature published in 1957 to 1965. Some references to works published before 1957 and material identified in Nuclear Science Abstracts during 1966 has also been included. Most references are provided with an abstract in English. The titles of the references are also in English; where the original language is not English, it is indicated in parenthesis. The main bibliographical source was Nuclear Science Abstracts, but other scientific journals, dealing with hydrology, meteorology, soil science, and nuclear techniques, were also consulted and abstracted. Abstracts of papers given at IAEA symposia on this subject were also included. The references are presented in alphabetical order; an author index and a keyword index, both computerized, are given at the end. (auth)

7504 (USGS-474-42) GEOLOGIC RECONNAISSANCE OF AMCHITKA ISLAND, ALASKA, DECEMBER 1966. Carr, W. J.; Gard, L. M. Jr.; Quinlivan, W. D. (Geological Survey, Denver, Colo.). Sep 1969. Contract AT(29-2)-474. 14p. Dep. CFSTI.

Geologic reconnaissance of the southeastern half of Amchitka Island has helped select five sites and one alternate site for deep drill holes. Stratigraphy and structure of the center part of the island are now fairly well known, and sites located there are favored over those toward the east and west ends of the island, mainly because of better predictability of lithology. (auth)

7505 (USGS-474-44) PROGRESS REPORT ON THE GEOLOGY OF AMCHITKA ISLAND, ALASKA. Amchitka-5 (Revised). Carr, W. J.; Quinlivan, W. D. (Geological Survey, Denver, Colo.). Sep 1969. Contract AT(29-2)-474. 16p. Dep. CFSTI.

The stratigraphy and structure of Amchitka are now fairly well known. The rocks were divided into an older group of breccias, exposed only on the eastern end of the island, the pillow lavas and breccias of Kirilof Point, the Banjo Point Formation, and the Chitka Point Formation. The Chitka Point Formation consists of andesite lava flows and breccias that were as much as 2,000 feet thick and unconformably overlie the Banjo Point. A complex of intrusive rocks was present on the east end of Amchitka. Intrusive rocks and extensively hydrothermally altered volcanic rocks were locally present beneath and within the Chitka Point Formation on the west part of the island. The middle third of the island, where sites B, C, E, and F was located, was composed of a series of fault blocks that repeated the southeastward-dipping section. The best area for additional sites from a geologic and terrain standpoint is the western end of Amchitka. (auth)

7506 (USGS-474-46) PRELIMINARY LITHOLOGIC LOG OF DRILL HOLE UAe-1 FROM 0 TO 5,028 FEET, AMCHITKA ISLAND, ALASKA. Gard, L. M.; Lee, William H.; Way, R. J. (Geological Survey, Denver, Colo.). Sep 1969. Contract AT-(29-2)-474. 3p. Dep. CFSTI.

In the first 5,028 feet, exploratory drill hole UAe-1 penetrated 1,395 feet of the breccias and mudstones of the Banjo Point Formation and then 3,633 feet of the glassy breccias and basalts of Kirilof Point. Caliper and geophysical logs are shown with a columnar section, lithologic descriptions, and core data. Magnetic susceptibility measurements of drill cuttings and cores below 2,600 feet are shown graphically. (auth)

7507 (USGS-474-47) PRELIMINARY LITHOLOGIC LOG OF DRILL HOLE UAe-1 FROM 5,000 TO 7,000 FEET, AMCHITKA ISLAND, ALASKA. Amchitka 6-1. Lee, William H.; Morris, R. H. (Geological Survey, Denver, Colo.). Sep 1969. Contract AT(29-2)-474. 4p. Dep. CFSTI.

Drill hole UAe-1 was drilled to a total depth of 7,000 feet. The major rock types penetrated by the drill hole were volcanic breccia, basaltic lava, sandstone, and siltstone. Lithologic data indicate that rocks favorable for the location of an underground nuclear test are present in the interval 5,000 to 6,000 feet. (auth)

7508 (USGS-474-49) RECONNAISSANCE GRAVITY SURVEY OF THE RAT ISLANDS, WITH EMPHASIS ON AMCHITKA ISLAND, ALASKA. Amchitka-7. Miller, C. H.; Kibler, J. D.; Tuttle, T. J. (Geological Survey, Denver, Colo.). Sep 1969. Contract AT(29-2)-474. 11p. Dep. CFSTI.

A gravity survey of 338 stations is presented as two simple Bouguer maps. The data show the similar gravimetry of Rat and Amchitka Islands with a regional gradient that decreases to the north at a rate of 0.5 to 1.5 mgals per mile. A gravity high at the east end of Amchitka Island and a low at the west end (a difference of 44 mgals) are anomalous compared to the gravity of its central part and to that of Rat Island. (auth)

7509 (USGS-474-50) PRELIMINARY LITHOLOGIC LOG OF DRILL HOLE UAe-3 FROM 0 TO 4,816 FEET, AMCHITKA ISLAND, ALASKA. Lee, William H. (Geological Survey, Denver, Colo.). Sep 1969. Contract AT(29-2)-474. 4p. Dep. CFSTI.

The exploratory drill hole UAe-3 penetrated 2,280 feet of the breccias and andesite (basalt) flows of the Chitka Point Formation, 1,320 feet of the breccias and basalts of the Banjo Point Formation, and 1,216 feet of the glassy breccias and basalt pillow flows of Kirilof Point. Caliper and geophysical logs are shown with a columnar section, lithologic descriptions, and core data. (auth)

7510 (USGS-474-53) PRELIMINARY LITHOLOGIC LOG OF DRILL HOLE UAe-2, FROM 3,580 FEET TO 6,500 FEET (T.D.), AMCHITKA ISLAND, ALASKA. Snyder, Richard P. (Geological Survey, Denver, Colo.). Sep 1969. Contract AT(29-2)-474. 3p. Dep. CFSTI.

Drill hole UAe-2, site B, Amchitka, Alaska, was drilled to a depth of 6,500 feet. The lithology of the upper 3,580 feet was reported by Snyder (1969). Gross lithologic units from 3,580 to 6,500 feet are: pillow lavas and breccias of Kirilof Point (3,580 to 5,248 feet) and older breccias (5,248 to 6,500+ feet). (auth)

7511 NATURAL RADIOACTIVITY OF SEDIMENTS: STRATIGRAPHIC TEST. Leveque, Paul; Vigneaux, Michel (Faculte des Sciences, Gironde, France). Compt. Rend., Ser. D, 269: 301-4(July 21, 1969). (In French).

The uranium content was determined in several oligocene and miocene samples from boreholes. The quantitative variations observed are arranged as a function of the stratigraphic results obtained previously and emphasize clearly the sedimentary cycles. This method of investigation should constitute a new standard for stratigraphic and paleogeographic interpretation. (tr-auth)

7512 TWO NEUTRON DETECTOR EARTH FORMATION POROSITY LOGGING TECHNIQUE. Locke, Stanley; Sherman, Harold; Wahl, John S. (to Schlumberger Technology Corp.). U. S. Patent 3,483,376. 9 Dec 1969. Filed 3 Aug 1966.

A typical embodiment of the invention comprises an earth formation porosity logging tool for use in open and cased boreholes. The tool contains a chemical neutron source spaced from a first helium-3 neutron detector. A second helium-3 detector is relatively more sensitive to neutrons than the first detector and is spaced vertically from the neutron source a distance at least equal to the spacing between the source and the opposite end of the first detector. This increased relative neutron response characterizing the second detector enhances the tool counting statistics and reduces the disparity between the signal intensities from both of the detectors, in spite of the smaller neutron population at the greater distance from the source. A circuit is coupled to the counters in order to convert the detector signals into a signal that corresponds to the formation porosity. (Offic. Gaz.)

7513 FEATURES OF THE APPLICATION OF GAS-DISCHARGE COUNTERS IN SELECTIVE GAMMA-GAMMA LOGGING ON COAL. Utkin, V. I. Yaderno-Geofiz. Issled., Geofiz. Sb.; No. 6, 83-5(1967). (In Russian).

It is shown that the optimum conditions for conducting selective gamma-gamma logging on coal deposits in the integral modification are satisfied when the detector is a gas-discharge counter with copper cathode and the source is thallium-204 or thulium-170. (Geophys. Abstr.)

7514 GROSS BETA RADIOACTIVITY IN SEDIMENTS OF THE NORTH ADRIATIC SEA. Schreiber, B.; Tassi Pelati, L.; Mezzadri, M. G.; Motta, G. Arch. Oceanogr. Limnol; 16: 45-62(1968).

Measurements of the gross beta radioactivity of the northern Adriatic Sea sediments showed that the superficial radioactivity is due chiefly to natural nuclides with a small portion due to radioactive fallout. The amount of radioactive fallout differed at the various stations and seemed to depend on the amount of clay component in the sediments. A clay core collected on the Po Delta showed radioactive fallout contamination in successive layers which made it possible to date the contamination by comparison of the gross beta stratigraphic curve of the core with curves relative to radioactive fallout in Italy in air and in Po River water. The coincidence of peaks permitted determination of the absolute age of the sediments. Data are tabulated. (Geophys. Abstr.)

7515 PRECISION OF NATURAL RADIOCARBON MEASUREMENT. Kim, S. M. (Illinois State Geological Survey, Urbana). Radiochem. Radioanal. Lett.; 2: 187-93(20 Dec 1969).

The natural variation of radiocarbon content is reported as Δ by many radiocarbon dating laboratories. In view of two different standards used for $\delta\ ^{13}C$ measurement and discrepancies in the reported data, the difference in Δ value calculated from using two different $\delta\ ^{13}C$ is studied and explained, and a suggestion is made for the proper adaption of the method of calculation. The discrepancies between reported data are explained by the precision analysis. The precision analysis shows that the relative error of within and between the laboratory is approximately 5% for radiocarbon age range up to 20,000 years. (auth)

7516 GEOTECHNICAL ASSESSMENT OF A SITE AT MUNDFORD, NORFOLK, FOR A LARGE PROTON ACCELERATOR. Ward, W. H.; Burland, J. B.; Gallois, R. W. (Building Research Station, Garston, Eng.). Geotechnique; 18· 399-431(Dec 1968).

The United Kingdom Government offered a large area on Middle Chalk near Thetford in Norfolk as a possible site for a giant proton accelerator for CERN. This 300 GeV machine has very stringent requirements for the ground stability and deformation under load which are outside normal civil engineering experience and practice. A description is given of how the suitability of the site in meeting these very exacting specifications was assessed. The load-deformation properties of the chalk mass were measured directly in the field by means of three inter-related methods rather than by means of laboratory tests on rock cores. First, the chalk was visually described and classified in situ into a series of five grades taking into account those features likely to influence its load-deformation behaviour. This was done by means of over 80 large (man-sized) auger holes spread over the site. Second, these grades were quantified in terms of load-deformation behaviour at one location by means of a full-scale loading test, using a water tank 18.3 m in diameter and weighing 4500 tonnes. Third, alongside the tank and at two other points on the site, the deformation properties of the grades were measured by means of sets of plate-loading tests (0.86 m diameter) carried out at various depths at the bottom of auger holes. These three methods together enabled the deformation properties of the whole site to be mapped from a visual description of the chalk. It was found

that geotechnically the site is acceptable for the construction of the large machine. (auth) (UK)

7517 SOME PROBLEMS OF PROCEDURE OF GAMMA-SPECTROMETRIC MEASUREMENTS IN COPPER ORE BOREHOLES. Sen'ko-Bulatnii, I. N.; Bakhterev, V. V.; Kharus, R. L. Yaderno-Geofiz. Issled., Geofiz. Sb.; No. 6, 13-19 (1967). (In Russian).

Gamma-spectrometric measurements in boreholes in copper deposits are concerned with the possible practical realization of activation logging with the procedure directed toward detection of gamma radiation from the short-period ^{66}Cu. This is achieved by using the features of the gamma spectrum of various activated isotopes with simultaneous recording of the applied gamma field in the energy ranges of 0.94 to 1.14 and 1.24 to 1.44 MeV. In comparison with the activation logging method in which the total effect of the gamma field is measured, spectrometric logging provides a substantial increase both in sensitivity of the method and in accuracy of quantitative determinations of Cu, and in the efficiency of operations. When there are considerable concentrations of Mn and (particularly) of Al in the ore, the sensitivity of spectrometric activation logging is not high enough when directed toward detection of gamma radiation from ^{66}Cu but spectral separation of gamma activity of ^{66}Cu, ^{56}Mn, and ^{24}Na is guaranteed with the use of an appropriate three-channel borehole gamma spectrometer. (Geophys. Abstr.)

7518 URANIUM, THORIUM, AND POTASSIUM CONTENT OF ROKKO GRANITIC BODIES, HYOGO PREFECTURE. Nishimura, Susumu (Osaka Univ.); Katsura, Kyozo. Ganseki Kobutsu Kosho Gakkaishi; 62: No. 1, 44-9(Jul 1969). (In Japanese).

The distribution of uranium, thorium, and potassium in Rokko granitic bodies was determined. These elements, especially uranium, had a tendency to concentrate in coarse-grained biotite granite rather than fine-grained. The atomic content of the bodies was: Rokko granite, 2.8 ppM U; 10.1 ppM Th; and 2.5% K: Nunobiki granodiorite, 1.8 ppM U; 6.2 ppM Th; and 1.4% K: Liparite, 2.2 ppM U; 6.0 ppM Th; and 3.1% K. (auth) (NSA of Japan)

7519 THE ISOTOPIC RATIO ^{234}U-^{238}U OF THE ORES AND WATERS IN TOGO MINE, TOTTORI-KEN, JAPAN. Umemoto, Shunji (Okayama Univ., Japan). Okayama Daigaku Onsen Kenkyusho Hokoku; No. 37, 31-6(1967). (In Japanese).

The ratio of ^{234}U: ^{238}U in two groups of ores and the waters collected in the Kannokura deposit was determined by α-spectrometry. According to geologic and mineralogic observations, ores of each group were formed in succession. Based on the assumption that ^{234}U: ^{238}U of the uranium in the leaching solution is higher than that in the ores, the ratio obtained supports the above mechanism of formation. Actually, waters collected in this deposit showed a fairly high value of ^{234}U: ^{238}U. Each stratum of a typical section of the mine was observed on the ratio, but the relationships of values obtained were much too complicated for interpretation. (Geophys. Abstr.)

7520 USE OF A COMBINATION OF RADIOMETRIC METHODS TO DETERMINE THE POSITION OF THE WATER OIL INTERFACE IN CARBONATE RESERVOIRS. Tslav, L. Z.; Laptev, V. V. Tr., Vses. Nauch.-Issled. Inst. Yadern. Geofiz. Geokhim.; No. 1, 226-34(1968). (In Russian).

The procedure and apparatus for a combination of neutron–gamma logging and neutron logging with thermal neutrons were developed for determining the oil–water interface in cased wells in carbonate reservoirs. The choice of sondes, the logging procedure, and some results obtained in 14 wells in different oil fields of the Kuybyshev district are presented. Despite certain limitations which are discussed, the procedure is recommended for work in carbonate reservoirs of high and medium porosity. (Geophys. Abstr.)

7521 POSSIBLE METHODS FOR A MULTILATERAL STUDY OF OIL WELLS BY PULSE-NEUTRON AND ACOUSTICAL METHODS. Mirchink, M. F.; Kuznetsov, O. L.; Sergeev, L. A.; Tslav, L. Z.; Deev, N. N.; Shimelevich, Yu. S. (Inst. of Geology and Treatment of Mineral Fuels, Moscow. All-Union Scientific Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). Dokl. Akad. Nauk SSSR; 187: 1274-7(21 Aug 1969). (In Russian).

Logging methods based on the use of acoustic and pulsed-neutron techniques yield good results with cased wells and with low-porosity or non-homogeneous strata. The neutron-based methods depend on the slowing down of fast neutrons, the diffusion coefficient of thermal neutrons, and their mean lifetime, τ. These indicators depend on the volume concentration of hydrogen, chlorine, and various other elements in the system. The acoustical methods involved determination of the velocity and damping of longitudinal and transversal waves or change of the frequency spectrum of the signal. Flooding of the strata must be determined by cased wells. Simultaneous use of the pulsed-neutron and acoustical methods makes it possible to determine more accurately the location of productive layers and to indicate the presence of gas-bearing regions. (TTT)

Meteorology

Refer also to abstracts 7496 and 7697.

7522 (STI/PUB-211) APPLICATION OF METEOROLOGY TO SAFETY AT NUCLEAR PLANTS. Safety Series No. 29. (International Atomic Energy Agency, Vienna (Austria)). Dec 1968. 27p. IAEA $1.50.

On April 10 to 14, 1967 the IAEA convened, in Vienna, a panel of eight experts from six countries to discuss the meteorological considerations which affect the safety of nuclear plants. These discussions are reported and include: site selection; design and construction; operations; emergency planning and action at nuclear establishments; and training. A simple method for computing air concentration values is described in the appendix. (auth)

7523 (TID-24868) ATMOSPHERIC TRANSPORT PROCESSES. PART I. ENERGY TRANSFERS AND TRANSFORMATIONS. Reiter, Elmar R. (Colorado State Univ., Fort Collins. Dept. of Atmospheric Science). Oct 1968. Contract AT(11-1)-1340. 253p. Dep. CFSTI.

The general circulation of the atmosphere is described, and specific properties of the atmosphere which are capable of transporting atmospheric characteristics, whether chemical constituents or dynamic properties, are discussed. Several phenomena, including angular momentum balance, energy fluxes and transformations in the general circulation of the atmosphere, and spectral considerations of eddy transports, are described by examining the derivation of theoretical equations and the numerical results obtained from computations using these equations. The importance of atmospheric transport studies to future air pollution control is mentioned. (L.C.L.)

7524 (UCRL-Trans-10403) FORMS OF RADIONUCLIDES ENCOUNTERED IN ATMOSPHERIC PRECIPITATION. Gedeonov, L. I.; Zhilkina, M. I.; Gritchenko, Z. G.; Flegontov, V. M. Translated by A. M. A. Mincer for Univ. of California Lawrence Radiation Lab., Livermore, from pp 181-90 of Conference on Investigations of Atmospheric Self-Scavenging Processes from Radioactive Isotopes, Palanga, Lithuanian, SSR, July 7-9, 1966. 19p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 17602.

7525 (UCRL-Trans-10404) CHARACTERISTICS OF THE WASHOUT OF A ^{32}P AEROSOL INJECTED INTO A CLOUD. Burtsev, I. I.; Burtseva, L. V.; Malakhov, S. G. Translated by A. M. A. Mincer for Univ. of California Lawrence Radiation Lab., Livermore, from pp 335-45 of Conference on Investigations of Atmospheric Self-Scavenging Processes from Radioactive Isotopes, Palanga, Lithuanian, SSR, July 7-9, 1966. 20p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 17618.

7526 (UCRL-Trans-10413) A REMARKABLE CASE OF INCREASED RADIOACTIVITY OF AIR NEXT TO THE GROUND SURFACE. Tomashenko, R. Translated by A. M. A. Mincer for Lawrence Radiation Lab., Livermore, Calif., from pp 283-91 of Issledovanie Protsessov Samoochishcheniya Atmosfery ot Radioaktivnykh Izotopov, Palanga, Lithuanian SSR, July 7-9, 1966. 10p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 17613.

7527 PRODUCTION OF MONODISPERSE SUB-MICRON AEROSOLS OF WHICH EACH PARTICLE CARRIES A SPECIFIED NUMBER OF ELECTRONIC CHARGES. Megaw, W. J.; Wells, A. C. (Atomic Energy Research Establishment, Harwell, Eng.). Nature (London); 224: 689-90(15 Nov 1969).

It is stated that experimental studies of aerosols can be simplified by producing the aerosols with particles of the same size and charge. The most convenient particles for such studies are often Dow polystyrene spheres, available as liquid suspensions with particle diameters ranging from 0.1 to 1μm, the aerosols being produced by diluting, spraying and drying. Such an aerosol contains a proportion of particles carrying very high electrical charges, with the result that experimental work, such as diffusion coefficient measurements, is vitiated, possibly due to image effects. Exposure of the aerosol to a concentration of small ions, such as from a radioactive source, can overcome these effects; the particles acquire a steady charge distribution and their electrical energy follows, to

a good approximation, a Boltzmann distribution. Such an aerosol will contain uncharged particles and progressively smaller numbers carrying one, two, three or more electronic charges, depending on the particle diameter. The use of a mobility spectrometer to employ this effect to produce a monodispose aerosol containing particles which are all uncharged or which carry a specified number of positive or negative charges is described. The aerosol must be used as soon as produced, since the production of small ions by background radiation may cause it to revert to a state of charge equilibrium. It is considered that the technique may have wide application in the study of electrical effects in deposition, filtration and inhalation of sub-micron particles in a more quantitative manner than previously possible. (UK)

7528 MERIDIAN TRANSPORT OF ARTIFICIAL RADIOACTIVE AEROSOLS IN THE TROPOSPHERE. **Hoang, Chi Trach; Servant, Jean (Centre National de la Recherche Scientifique, Gif-sur-Yvette, France). Compt. Rend., Ser. B, 269: 270-2 (Aug. 4, 1969). (In French).**

The study of the agreement of strontium-90 concentration in the air at the ground-level and in rainwater from 1963 to 1965 showed that this agreement was weaker in middle latitudes than in subtropical latitudes. From this it is deduced that artificial radioactive aerosols originating in the stratosphere reach directly the rainy zone in temperate regions and layers of air near the ground in subtropical regions. (tr-auth)

7529 NATURAL AND ARTIFICIAL RADIOACTIVITY OF THE AIR IN GHENT (BELGIUM). **van Cauwenberghe, A. R.; Bosch, F. M. (Univ., Ghent). Atmos. Environ.; 3: 633-41 (Nov 1969).**

Daily measurements of the β-radioactivity of the air have been made in Ghent since 1959. The air-filter method was used. Measuring the β-activity of the dust collected on the filter immediately after sampling gave a measure of the natural radioactivity. The artificial radioactivity (or radioactive pollution) was determined by measuring the β-activity of the filter after 5 days. It was found that the artificial radioactivity was considerably less than the natural radioactivity (say 0.1 $pC^i\ m^{-3}$ vs. 50 pCi m^{-3} air). There was a clear dependence of the measured radioactivity on the weather type and wind direction. A seasonal influence was also observed. These are considered in detail. To obtain a quantitative understanding of the observed variations in radioactivity level, the measured β-activity was statistically modelled as a function of some meteorological variables (such as the air temperature, pressure and humidity; the amount of precipitation; the wind velocity and direction) and of the atmospheric polution (as measured by the degree of blackness of the filter). Previously observed dependencies were confirmed and some, which were less obvious before, were revealed by this analysis. (auth) (UK)

7530 RADIOACTIVE-CONTAMINATION BY FALLOUT IN THE TOKUSHIMA DISTRICT. III. **Kinouchi, Tsuneo (Tokushima Univ., Japan). Tokushima Daigaku Gakugei Kiyo, Shizenkagaku; No. 19, 11-18(Mar 1969). (In Japanese).**

The third investigation concerning the radioactive contamination in Tokushima district observed during the period from May in 1967 to September in 1968 is reported. The radioactive contamination of the rain water, of airborne debris and of the soil was investigated. Such investigation was performed to get correlation between them, and also to compare the contamination present with those of previous investigations. The results obtained in this investigation were as follows: the intensity of radioactivity of the airborne debris shows peaks every 40 days or 50 days; the radioactivities of the rainwater and of the airborne debris are most intensive in spring, moderate in fall and less in summer and winter (this result is the same as the former investigations); the radioactivities of the rainwater and of the airborne debris decreased gradually during 1967 to 1968 and were about half the amounts measured in 1966; and the same result was found in the soils. According to group separation with ion exchange resin, the radioactivity of rare earth elements accounts for 50 ± 10% of the radioactivity of the rainwater, of the airborne debris and of the soil. (NSA of Japan)

7531 A STUDY OF FISSION PRODUCTS AND SINGLE FALLOUT PARTICLES IN THE ATMOSPHERE. **Baugh, James Owen. Fayetteville, Ark.; Univ. of Arkansas (1969). 118p.**

Thesis.

A program of daily air-filter sampling was conducted for six months following the Chinese nuclear explosion on December 24, 1967. These air-filter samples consisted of approximately 3,000 cubic meters of ground-level air collected at the chemistry building of the University of Arkansas, Fayetteville, Arkansas. In each sample the concentration of fallout particles was determined by means of autoradiography, and the fission product concentrations were determined by means of gamma spectroscopy. The gamma spectra were analyzed by the least squares technique using a computer program. The daily fallout particle concentration showed a definite cyclic pattern of variations, which was due to the nuclear debris circling eastward around the earth at about the same latitude and again appearing at this site a number of times with a period of about 18 days. Several ratios of different fission products (^{140}Ba, ^{147}Nd, ^{131}I, ^{95}Zr, ^{141}Ce, ^{144}Ce, ^{103}Ru, and ^{106}Ru) were followed, and a cyclic pattern of variations was observed in each ratio, which closely corresponded to the cyclic variations of the fallout particle concentration. It was also noted that the cyclic patterns of the variations of the ratios of volatile isotopes and refractory isotopes did not coincide. These results seem to demonstrate the atmospheric fractionation phenomena on a global scale. The differences in the variations of the ratios of the two types of fission products appear to be greatest for the first two arrivals of the fresh debris and to be mostly diminished by the third arrival. (Disser. Abstr.)

Mineralogy and Exploration

Refer also to abstract 7495.

7532 (WASH-1128) URANIUM IN THE SOUTHERN UNITED STATES. Final Report. **(Southern Interstate Nuclear Board, Atlanta, Ga.). 1 Jul 1969. Contract AT(49-6)-3003. 246p. GPO $2.25.**

All known occurrences of uranium and some references to thorium in a 17-state area of the southern USA are reported. These occurrences are evaluated as potential sources of uranium. Recommendations are made for future action by the states involved, federal agencies, and private industry. (L.C.L.)

7533 PARAGENESIS OF URANIUM AND SELENIUM IN MULTICOLORED MESOZOIC-CENOZOIC DEPOSITS. **Vorob'ev, V. P.; Grushevoi, G. V.; Onoshko, I. S. Tr. Vses. Nauch.-Issled. Geol. Inst.; 142: 114-21(1968). (In Russian).**

The contents of U in most rocks of a Mesozoic–Cenozoic varicolored formation of a platform were within rock Clarke values for most of the rocks and varied little although the facies conditions of the rock formation were variable. The U content increased from carbonate rocks (1.2 to 1.4 ppM) to shales (3.1 ppM). The degree of rock oxidation did not noticeably affect the U content in them although the red bed siltstones had twice as much U as the gray siltstones. The distribution of Se, on the contrary, was controlled by reduction-oxidation conditions of sedimentation. All reduced rocks, black, gray, green, and bluish gray-green in color, have elevated contents of Se. Syngenetic enrichment in U and Se was observed in 2 horizons formed under sharply reducing conditions: Eocene black sapropel clays and Albian dark gray sandstones contained numerous fragments of coalified original substances. In the clay, the contents of both elements increased with increased amounts of original substances. The correlation between U and Se contents, observed in unoxidized rocks, indicated a parallel accumulation of these elements during sedimentation. Deposits of oxidized geochemical facies were poor in Se and contained the Clarke value of U. The content of U in geochemical facies was within the Clarke values whereas Se accumulated in moderate amounts. Sharply reducing geochemical facies were favorable for the formations of syngenetic Se–U concentrations of both elements fixed mostly by original substance of the sediment. (Selenium – Tellurium Abstr.)

7534 NATURAL OCCURRENCE OF URANIUM IN JAPAN. PART 2. **Hida, Noboru (Geological Survey of Japan, Kawasaki): Koseki, Koji. Chishitsu Chosajo Hokoku: No. 232, 1-986(Mar 1969). (In Japanese).**

The results of the survey and investigation of uraniferous deposits except chemical precipitation deposits in the sedimentary rocks have been issued previously. Recent survey activities, distribution, characteristics of the main uranium deposits, and the summary of occurrence of sedimentary types of deposit are reported. An outline of the main uranium deposit districts is given. Basement granites of uranium deposits, results of petrographical and petrochemical studies of the main deposits districts, minor quantity of uranium and thorium in the granite and other rocks, results of geochemical study of the main uranium deposits, result of paleontological and stratigraphical studies of uranium bearing sediments, results of the radiometric survey and radiometric logging method and some geophysical methods are reported. (NSA of Japan)

Seismology

Refer also to abstract 7539.

7535 (NVO–1163–181) AMPLITUDE AND FREQUENCY CHARACTERISTICS OF ELASTIC WAVE TYPES GENERATED BY UNDERGROUND NUCLEAR EXPLOSIONS. Hays, W. W.; Murphy, J. R. (Environmental Research Corp., Alexandria, Va.). 21 Apr 1969. Contract AT(29-2)-1163. 60p. Dep. CFSTI.

Elastic wave types were identified on seismograms recorded from three Pahute Mesa (Boxcar, Stinger, and Rickey) and two Yucca Flat (Zaza and Lanpher) detonations utilizing the basic information contained in the seismogram; i.e., the first arrival times and particle motion characteristics. The amplitude characteristics of the identified elastic wave types were determined to vary with yield, source-recording station distance, and frequency. The surface wave and the direct P and S wave modes appear to scale approximately as the first power of yield, whereas refracted and reflected P and S wave modes scale approximately as the 0.6 power. The peak amplitude of body wave window spectra occurs at higher spectral frequencies for the two Tonopah, Nevada stations (especially Tonopah Motel). The frequency of the spectral peak for each wave mode time window shifts slightly from higher to lower values with increase in yield, but is essentially constant with increase in propagation distance over the distance range 22.2 to 79.1 km. Reduction of high frequencies by the low-pass filtering action of the earth is essentially insignificant over this distance range. (auth)

7536 (PNE–958) ANALYSIS OF GROUND MOTION, CABRIOLET EVENT. Klepinger, R. W.; Mueller, R. A. (Environmental Research Corp., Alexandria, Va.). 16 Jul 1969. Contract AT(29-2)-1163. 67p. Dep. CFSTI.

The Cabriolet event was a Plowshare nuclear cratering experiment detonated in Area 20, on the Nevada Test Site. Ground motions from Cabriolet were monitored and data processing and post-shot analyses performed. Band-pass filter spectra from several contained events (Rex, Duryea, and Knickerbocker) were theoretically scaled to the Cabriolet yield and depth. Comparison of these spectra with the Cabriolet spectra at common stations indicates that most of the seismic energy from a cratering shot is generated before the fireball breaks the surface and energy is released into the atmosphere. Analysis of these spectra indicates that for shots detonated at a relatively shallow depth, less high frequency energy is generated. Examination of Cabriolet peak amplitude data and comparison of this data with contained event experience suggest that there are relatively small differences in amplitude levels between hard rock and alluvium stations. Further analysis suggests that generation of significantly less high frequency energy from cratering events than from contained events may be a factor contributing to lower amplification of peak ground motions at alluvium stations. (auth)

7537 (PNE–1014) SEISMIC MEASUREMENTS: PROJECT GASBUGGY. Navarro, Richard (Coast and Geodetic Survey, Las Vegas, Nev. Special Projects Party). 29 Feb 1968. 46p. (PNE-G-50). Dep. CFSTI.

Project Gasbuggy was a nuclear detonation conducted in the Pictured Cliffs sandstone in the San Juan Basin, Rio Arriba County, New Mexico. The explosion had a design yield of 26 kt and a maximum yield of 31 kt. The Gasbuggy seismic signal in the distance range of from 0.752 to 89.955 km was recorded at 36 seismograph stations. Generally the stations were located by structures situated in populated centers, near the site. The largest populated town was Farmington, New Mexico where reports of perception were documented. Maximum scaled transitory displacements were below the predicted, while due to the high frequency content of the seismic signal the maximum seismogram earth particle velocities and accelerations were close to the predicted values. The best calculated expressions for the maximum trace earth particle velocities on hardrock and alluvium satisfied the following formulas: $V = 167\ R^{-1.72}$ in hardrock and $V = 349\ R^{-1.74}$ in alluvium. All attenuation expressions calculated indicated relatively high attenuation in all directions from the event. Inspection of the maximum component displacements indicated that the expected high frequency seismic signal traveled through generally uniform geology in a compressional manner. An average propagational velocity of 5.23 km/sec was calculated, in a range of 16 to 90 km. (auth)

7538 QUANTITATIVE EVALUATION OF SEISMIC SIGNALS AT TELESEISMIC DISTANCES. I. RADIATION FROM POINT SOURCES. Hudson, J. A. Geophys. J. Roy. Astron. Soc.; 18: 233-49(Nov 1969).

The aim of the studies described is to follow up and improve Carpenter's (1966) attempt to construct realistic pulse shapes for teleseismic body waves from underground explosions. Both explosions and shallow earthquakes are considered, as well as the radiation of surface and body waves. A point source can be represented either as a system of forces or as a discontinuity in the displacement or stress or their derivatives across an element of surface. It is shown that a general source of either type is equivalent in the generation of elastic radiation to a discontinuity across a horizontal plane in the displacement and the stress acting on the plane. This means that any point source can be put into a form suitable for computations based on the Thomson–Haskell theory. The theory is applied to the construction of theoretical models of earthquake and explosive sources. Some of the more realistic models so far proposed are described. (auth) (UK)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 7500, 7506, 7535–7537, 7543, 7547, 7695, 7696, 8165, 8190, and 8215.

7539 (CGS-E-101) EVENT STERLING SEISMIC REPORT, HATTIESBURG, MISSISSIPPI. (Coast and Geodetic Survey, Las Vegas, Nev. Special Projects Party). Jan 1967. 29p. Dep. CFSTI.

During the months of November and December, 1966, twenty-three seismic stations in or near residential buildings within six kilometers of Surface Zero and in towns in the vicinity of Event STERLING were installed and operated. Seven of the twenty-three stations operated for a high explosive calibration shot preceding Event STERLING. One hundred-one channels of acceleration, displacement, and velocity were operated for Event STERLING and thirty channels for the high explosive shot. Overall operational success rate of 94% was achieved. From the seismic data, it would appear that the known threshold of damage was not exceeded for either event. (auth)

7540 (PNE-326) ANALYSIS OF GROUND MOTION: BUGGY I EVENT. Cassity, C. R.; Klepinger, R. W.; Lahoud, J. A.; Murphy, J. R. (Environmental Research Corp., Alexandria, Va.). 12 Dec 1969. Contract AT(29-2)-1163. 62p. Dep. CFSTI.

The Buggy I event was a Plowshare nuclear row-charge cratering experiment detonated in Area 30, on the Nevada Test Site. The close-in (<12 km) Buggy I seismic data have been analyzed to determine if any azimuthal asymmetries are present in the seismic radiation pattern. The conclusion, based on peak amplitude, BPF amplitude, and energy density data, is that no measurable asymmetries are in evidence in the seismic data. The distant seismic data from Buggy I have been compared with measurements from previous tests to determine if a single equivalent charge could be postulated for prediction purposes. It was concluded that the Buggy I data are unlike those expected on the basis of a single charge cratering experiment and are very similar to those that would be expected from a single contained shot with the yield of one of the elements of the Buggy I row. (auth)

7541 (PNE-963) CABRIOLET SURFACE-MOTION AND VENTED-GAS TEMPERATURE MEASUREMENTS. Rohrer, Robert F. (California Univ., Livermore. Lawrence Radiation Lab.). Jun 1969. 103p. (UCRL-50695). Dep. CFSTI.

Surface-motion data as a function of time is presented for the Cabriolet nuclear cratering event. Data for the surface-motion time history up to the time of vent were obtained through the use of surface flares, high-speed photography, and film analysis with a digital computer. A falling mass at ground zero (GZ) was used to study the early mound velocity up to 300 msec. Graphs show vertical and horizontal displacement and vertical velocity of individual surface-motion targets vs time. Also discussed are the time history of the vented-gas temperature as a function of time, the use of special film exposed at vent time so the temperature of the vent image on the film could be determined, and how the peak temperature recorded is related to late cavity pressure. (auth)

7542 (UCRL-72087) POSSIBLE TECHNIQUES FOR DECONTAMINATION OF NATURAL GAS FROM GAS WELLS STIMULATED BY A NUCLEAR EXPLOSION. Wethington, John A. Jr. (California Univ., Livermore. Lawrence Radiation Lab.). 1 Oct 1969. 8p. (CONF-700101-1). Dep. CFSTI.

From Meeting on Engineering with Nuclear Explosives, Las Vegas, Nev.

Decontamination of the products from gas wells stimulated by nuclear explosions requires the removal of T, present as HT, CH_3T, C_2H_5T, etc., and ^{85}Kr from the production stream. Flaring of large volumes of gas from the Gasbuggy well led to the replacement of radioactive cavity gas with inactive formation gas, but this would not be a satisfactory production procedure because it releases T and ^{85}Kr into the atmosphere and wastes large amounts of product gas. Exchange reactions appear to offer promise for removing the tritium. For example, water or steam flowing countercurrent to tritiated gas in the presence of a suitable catalyst can participate in the exchange reactions $CH_3T + H_2O \rightleftharpoons CH_4 + HTO$, and $HT + H_2O \rightleftharpoons H_2 + HTO$, resulting in the transfer of T from gas into water. Other possibilities for utilizing exchange reactions include exchange of the gas with ethylene glycol used in the gas dryer, with silicate rocks introduced into the gas stream, or with a countercurrent stream of NH_3 or H_2S. As another approach, use of the contaminated gas for the manufacture of ammonia synthesis gas has potential for removal of both T and ^{85}Kr. (auth)

Facilities and Equipment

Refer also to abstracts 7839, 7862, 7893, 7904, 8055, 8165, 8204, 8419, and 8791.

7543 (AD-693817) PROJECT TANK TRAP: A FIELD EVALUATION OF NUCLEAR TERRAIN BARRIERS. Final Technical Report. Hughes, Bernard C.; Harrison, William L.; Paul, Roger (Army Engineer Nuclear Cratering Group, Livermore, Calif. Army Tank-Automotive Command, Warren, Mich. Land Locomotion Lab.). Jun 1969. 82p. (NCG-TR-17). CFSTI.

Project TANK TRAP was conducted to determine the capability of selected tactical vehicles to traverse craters typical of those which could be produced with Atomic Demolition Munitions (ADM). The vehicles included in the test program were the M-60 Tank, M-113 Armored Personnel Carrier, and an articulated two-unit general purpose vehicle called the POLECAT. Trafficability testing of these vehicles was performed in the SCOOTER crater, the JANGLE U crater, and Pre-SCHOONER BRAVO crater. (auth) (USGRDR)

7544 (AI-AEC-12878) CHARACTERISTICS OF AEROSOLS PRODUCED BY SODIUM FIRES. VOLUME II. COMPARISONS OF EXPERIMENT WITH A GENERAL EQUATION FOR THE COAGULATION OF HETEROGENEOUS AEROSOLS. Greenfield, M. A.; Koontz, R. L.; Hausknecht, D. H. (Atomics International, Canoga Park, Calif.). 31 Oct 1969. Contract AT(04-3)-701. 35p. Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

A comparison between solutions of a modified equation with experimental results is reported. Liquid sodium at 1000°F was exposed to an environment containing 4 to 21% oxygen. Some fraction of the oxidized sodium was released as an aerosol in a test chamber. Measurements were made of the airborne mass concentration, mass deposition rates on the floor and walls, and the particle size distribution, each as a function of time. Solutions of the general equation have been obtained by use of a digital computer, and comparisons were made with experimental findings. The model presented should help in providing an analytical approach in the safety analysis which describes the behavior of aerosols assumed to be released during a major liquid-metal cooled fast-breeder reactor accident. (J.C.W.)

7545 (GAMD-9116) DEVELOPMENT OF AN ATTACHMENT FIXTURE FOR CLASS A FIBROUS THERMAL BARRIER FOR THE PUBLIC SERVICE COMPANY OF COLORADO 330-MW (E) FORT ST. VRAIN REACTOR PLANT. Jones, G. (Gulf General Atomic, Inc., San Diego, Calif.). 3 Nov 1969. Contract AT(04-3)-633. 66p. Dep. CFSTI.

The stress analysis and research work involved in developing the attachment fixture for the Class A thermal barrier on the 330-MW(e) High-Temperature Gas-Cooled Reactor (HTGR) are described. The environmental conditions of the plant for which the Class A thermal barrier was designed are flowing helium at 700 psia and 755°F at 100% power level. The thermal barrier chosen for use in the plant basically consists of a series of fibrous blankets compressed onto the inside surface of the prestressed concrete reactor vessel liner by 1/4-in. steel cover plates. On the majority of the reactor liners, including the vertical walls, a redundancy principal is used in which a second series of blankets and cover plates are installed over the first. The attachment fixture is so designed that the outer blanket layer may lose all resiliency, that is it may creep under high temperature conditions, without affecting the degree of compression of the inner layer. The fibrous blanket material is Kaowool, and the degree of compression was chosen for a balance between the decreasing gas flow permeation and the increasing loading on the cover plates and attachment fixtures with an increasing amount of compression. The pressure range that would be required to compress new Kaowool to the design compression figure of 70% of the nominal thickness was calculated, and the components of stress caused by the effects of this compression on the weld stud and post in the attachment fixture were defined. An analysis of these stresses was carried out and related to fatigue-test data generated on several different configurations of weld stud. An optimum attachment fixture configuration and stud welding and prestressing procedure was established to ensure adequate fatigue life. (L.C.L.)

7546 (NP-18048) USE OF RADIOISOTOPES IN PREPARATION OF POULTRY WASTES FOR FURTHER USE. Jackson, W. M. (American Nuclear Corp., Oak Ridge, Tenn.). 1968. 8p.

In view of the problems of increasing pollution from poultry wastes and the inefficiency of poultry in utilizing feed, an irradiator was developed for sewage and animal wastes. It is almost 100% efficient in utilization of γ energy from ^{60}Co or ^{137}Cs. The device is illustrated. A unique feature is the provision for removal of the solids from the inner walls of the irradiator; this eliminates reduced dose to the liquid and impedance of flow. The granular, odor-free product may be blended back into feed at the 10 to 15% level, or used directly as feed for commercial fish and oyster farming or as fertilizer in agriculture. It is concluded that the economic potential is enormous. (C.O.)

7547 (NVO-38-20) BROWN OIL TOOL UNDERREAMING OPERATIONS, U-20P PAHUTE MESA, NEVADA TEST SITE, MERCURY, NEVADA. (Fenix and Scisson, Inc., Las Vegas, Nev.). Jul 1969. Contract AT(26-1)-38. 50p. Dep. CFSTI.

The overall performance of a large diameter underreamer for remotely constructing underground spaces up to 20 ft in diameter below a large diameter casing was evaluated. Modifications in specific components of the equipment and in operating procedures are recommended. It was concluded that the underreaming of the hole to 21 ft in diameter by the Brown Oil Tool underreamer used was a successful operation. (L.C.L.)

7548 (NYO-3839-7) A STEAM-LUBRICATED ROTOR-BEARING SYSTEM: DESIGN FOR AN EXTENDED DURATION (500 HOUR) TEST. Quarterly Report No. 1. Malanoski, S. B. (Mechanical Technology Inc., Latham, N. Y.). Oct 1969. Contract AT(30-1)-3839. 20p. (MTI-69-TR-52). Dep. CFSTI.

Steam-lubricated rotor-bearing systems for possible use in steam turbines in nuclear power plants are being investigated. Modifications in the design of a rotor-bearing system being fabricated for this investigation are described and included: shortening the rotor and making it from one forging in order to reduced vibration effects at high speeds; and revision of the bearing design to reduced sensitivity of the bearings to high speed rubs in the restrictor region. (L.C.L.)

7549 (NYO-3930-5) DESIGN DATA: HYDRODYNAMIC JOURNAL BEARINGS FOR LARGE, HIGH TEMPERATURE SODIUM ROTATING MACHINERY. Smalley, A. J. (Mechanical Technology Inc., Latham, N. Y.). 1968. 400p. Dep. CFSTI.

Design data for self-acting journal bearings for large liquid sodium rotating machinery are presented. Several candidate bearings, including four axial groove bearings, shrouded step bearing, and tilting pad bearing, were analyzed in detail for the range of operating conditions likely to be met in large liquid sodium applications. The design data provided, enables a choice of one of these bearings to be made for a particular application, and allow determination of the bearing geometry and size which will provide the required performance. (L.C.L.)

7550 (ORO-3411-12(Pt.4)) A STUDY OF THE OPERATING CHARACTERISTICS OF THE HEAT PIPE. PART IV. HEAT TRANSFER IN THE EVAPORATOR ZONE OF A HEAT PIPE. Final Report. Ferrell, J. K.; Johnson, H. R. (North Carolina State Univ., Raleigh. School of Engineering). Apr 1969. Contract AT(40-1)-3411. 150p. Dep. CFSTI.

The heat transfer mechanism in the evaporator section of a heat pipe was studied. Since several operating features of a typical heat pipe tend to complicate an experimental investigation of the heat transfer phenomena in the evaporator section, a controlled environment heat pipe was designed and operated. This controlled environment heat pipe was divided into an adiabatic section and an evaporator section. Both sections consisted of a rectangular duct which was completely filled with small particles to form a porous wick. One end of the adiabatic section was immersed in a pool of the working fluid which flowed by capillary action to the evaporator section where it was vaporized. The upper surface of the wick in this section was uncovered to permit disengagement of the vapor. The heat pipe was wholly enclosed within a flanged glass pipe which was filled, during operation, with vapor from an auxiliary pool of the working fluid to provide a constant temperature and pressure environment. Experimental data were obtained to determine the relationship between heat flux and temperature difference between the heated surface and the wick and to determine the limiting operation conditions. The heat flux-temperature difference data were obtained at atmospheric pressure using water as the working fluid and monel and glass particles for the wick. Data on the limiting operating conditions were obtained for monel particles using the same working fluid and at the same pressure. The particles ranged in size from 149 to 590 microns and the heat flux range was from 1,500 to 80,000 Btu/hr-ft^2. Based on initial data, a mechanism to describe the heat transfer phenomena was proposed which considered that heat transfer from the heated surface occurred by conduction with vaporization of the liquid occurring at vapor-liquid interfaces located in the layer of particles covering the surface, and that the critical heat flux was obtained when the capillary forces were no longer sufficient to keep a major part of the heated surface wet. Based on this proposed mechanism, theoretical expressions were developed for predicting an over-all heat transfer coefficient and the critical heat input. The agreement between the predicted and experimental values of the over-all heat transfer coefficient was excellent for normal conditions of the wick and the normal operating range. Even when the wick conditions were not normal, i.e., the bottom layers of particles fused to each other and to the heated surface, the proposed mechanism of heat transfer by conduction was still valid even though the predicted values were larger than the experimental ones. Also, it was shown that the upper limit of the normal operating range could be predicted and depended upon the limits of the particle size range used for the wick and the critical heat flux. The agreement between the predicted and experimental values for the critical heat flux was excellent when proper values were selected for the cross-sectional areas for vapor and liquid flow in the evaporator section. The selection of these values was necessary since no theoretical or experimental method was developed for predicting them. (auth)

7551 (RFP-1409) EFFECT OF MACHINING VARIABLES ON TOOL TEMPERATURES. Pippin, Clarence A. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 21 Nov 1969. Contract AT(29-1)-1106. Dep. CFSTI.

The effect of machining variables on tool temperatures was studied in order to obtain the temperature-distribution patterns at the tool tip. Four distances (depths) below the top surface of the tool bit were investigated, and results have been tabulated. The depths of cut were varied between 0.005 and 0.040 inches and the feed rates ranged from 0.0021 to 0.0167 inches per revolution. The cutting speed was maintained at approximately 400 feet per minute. Surface temperatures were determined by extrapolation from the four depths experimentally investigated. The maximum tool-surface temperature was 614°F, at a 0.040-inch depth of cut and a feed of 0.0167 inches per revolution. The experimental work was done on Type-6061T6 aluminum which was easy to use. It is expected that such work will be useful to Rocky Flats as soon as random determinations can be made on plutonium. (auth)

7552 (TID-4100(Suppl.55)) ENGINEERING MATERIALS LIST. Smith, Richard J.; Sachs, Francis L.; Clark, Willie E. (eds.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Dec 1969. 48p. DTIE Free.

Twenty-four packages of engineering drawings and specifications are presented. Packages of drawings are included on a free-surface type centrifugal pump, hydrostatic pressure cell, calibration facility, omni-directional vacuum gage probe, terminal and relay blocks, low temperature stage for Picker theta-theta x-ray diffractometer, open end ratchet wrench, 2X-vacuum system, cryogenic system for Baseball II magnet, minimum ionization particle detector, gamma radiation monitoring system, ultrasonic incipient boiling detector, Astron 1.4 meter magnet, automatic gas delivery system, precision staircase calibrator, EPUT multiplexer coder and driver and decoder, spectrophotometer glove box, complementary pair feedback amplifier, trisonic wind tunnel, vibrating sample magnetometer, vertical assembler dismantler, Rossi injection box, and dual-cell assembly for high-temperature mass spectrometer calibration. A subject index is included. (L.C.L.)

7553 IMPROVEMENTS IN OR RELATING TO FIRE EXTINGUISHER FITTINGS. Carter, Leslie William (to United Kingdom Atomic Energy Authority). British Patent 1,170,482. 12 Nov 1969. Filed 10 May 1967.

Fire fighting equipment for closed chambers (including glove boxes) or similar enclosures, where it is desirable, if not essential, to miminize communication with the outside environment is described. The apparatus comprises an adaptor which penetrates a wall of the chamber, the outer end of the adaptor being provided with a self-sealing end unit to receive the nozzle of a fire extinguisher, and the bore of the adaptor being sealed by a thin frangible disk prior to insertion of the nozzle. The self-sealing end unit is preferably provided with releasable means so that it remains integral with the nozzle. The frangible disk may be of a thermoplastic material and retained between two resilient members within the adaptor bore. The self-sealing end unit may include a spring-loaded disk valve with seating. (UK)

7554 THE ASYNCHRONOUS MACHINE WITH SUPERCONDUCTING SECONDARY WINDING. LIMITING VALUES OF TORQUES IN THE TRANSIENT STATE OF THE NORMAL MACHINE. Leonhard, A. (Univ., Stuttgart). Arch. Elektrotech (Berlin), 52: 205-10(Feb. 4, 1969). (In German).

The largest possible limiting torque in the transient state for the asynchronous machine is deduced from an investigation of the

machine with superconduction in the secondary winding. In the transient state an asynchronous machine has additional torques besides the torque dependent on the rotor slip. The maximum values of these additional torques are functions of several factors, especially the acceleration constant and the critical slip. It is shown that the asynchronous machine with a superconductive secondary winding, which is of considerable theoretical interest, can function as a synchronous machine. The maximum value of its torque is found to be equal to the doubled critical torque of a normal asynchronous machine. In practice this value has not yet been achieved; the reason for this failure is both the present impracticality of attaining a superconducting secondary winding (i.e., secondary resistance) and also the fact that, in general, a working machine is coupled to the asynchronous machine. (BBB)

7555 NUCLEAR FUEL ELEMENT. Nakai, Yasushi (to Mitsubishi Atomic Power Industries, Inc.). Japanese Patent 1969-16077. 16 Jul 1969. Filed 2 Feb 1966.

The nuclear fuel element proposed is made of an outer tube, and central fuel rods. Cooling liquid removes heat as it flows upward between the outer tube and fuel rods. The advantages are restoration of original position of the fuel rods when it is vibrated by coolant flow, the attenuation of the vibration, the limiting of the amplitude of vibration within a certain range, and the simple over-all construction. The central fuel rod consists of short clad fuel-rods connected end to end by screws. At the position of this connection, a circular plate is inserted around the short fuel rod. On the circumference of the plate, four vibration damping plates, extending radially at 90° intervals, close to the inner surface of the outer tube are welded; the plates are on the planes containing the axis of the central fuel rod. Small holes are drilled in the plates, for cooling liquid to flow through them. (NSA of Japan)

7556 CONTAINER FOR A HEAT-EMITTING MATERIAL. Omori, Norihiko (to Mitsubishi Atomic Power). Japanese Patent 1969-18698. 12 Aug 1969. Filed 14 Sep 1963.

In the container proposed for a heat-emitting material, e.g., an irradiated test specimen, the temperature of the material can be maintained automatically in a given temperature range; the space required is small and the temperature control is certain. The wall of the container is made of alternate layers. One of the layers is made of a material which does not melt at the temperature of the contained heat-emitting material, and the other group of layers is made of materials which melt at temperatures above the given temperature-range set for the heat-emitting material. The melting points of these second layers are lower toward the outmost layer. The innermost and the outermost layers are made of high melting point material. Cooling liquid surrounds the outer layer. When the temperature of the heat-emitting material is below the given range, the low-melting point layers remain solid; then, the over-all heat transfer to the cooling liquid is low. When the temperature exceeds the determined range, however, the heat transfer is raised by melting of the low melting point materials. (NSA of Japan)

7557 STUDY ON PERMANENT-MAGNET FLOWMETER FOR LIQUID SODIUM. I. THEORETICAL INVESTIGATION OF END EFFECT OF MAGNETIC FIELD. Kobayasi, Kiyoshi; Kudo, Akio (Tohoku Univ., Japan). Nippon Genshiryoku Gakkaishi; 11: 669-75(1969). (In Japanese).

A theoretical study on the end effect of circular transverse field electromagnetic flowmeters is described. It is shown that the voltage induced between the top and bottom electrodes is not strictly proportional to the mean velocity but is slightly influenced by the velocity distribution of the fluids, due to end effect. The difference in the sensitivity of the flowmeter between turbulent and laminar flows is practically negligible when the intensity of the magnetic field/diameter of the pipe is >1.5. Calculated results for the induced voltage are presented for the case where the pipe wall is a conductor and the magnetic field distribution arbitrary. As examples the end effect, correction factors were calculated for the case where liquid sodium and 304 stainless steel are used as fluid and pipe wall. (auth)

7558 PENETRATION IN A REACTOR CONTAINMENT VESSEL FOR ELECTRIC WIRES. Ebata, Takeo (to Hitachi Ltd.). Japanese Patent 1969-16294. 18 Jul 1969. Filed 3 Dec 1965.

The method proposed for introducing electric wires into a reactor containment vessel has the following advantages: maintenance of air-tightness and prevention of any leakage at the point of penetration through the containment-vessel wall; simplification of introducing electric wires into the containment vessel without using special wires; and high economy. A short cylinder is inserted through the wall of the reactor containment vessel. Both ends of this cylinder are closed with flanges with holes for the electric wires to pass through. The interior of the short cylinder is partitioned by circular plates, which slide along the inside of the cylinder; holes are drilled through the plates for the wires to pass through. The electric wires are run through the holes from outside into the containment vessel, at an appropriate time. The spaces thus produced by partitioning are filled alternately with some elastic sealing-material and foam-producing material. The expansion in volume of the foam-producing resin, when it hardens, forces the appropriate partitioning plates and hence the adjoining elastic sealing material to move in the axial direction. (NSA of Japan)

7559 IMPROVEMENTS RELATING TO SERVICING TOOLS FOR NUCLEAR REACTORS. Bailey, Alan; Hall, Peter John Scrivener (to Fairey Engineering Ltd.). British Patent 1,168,853. 29 Oct 1969. Filed 25 Apr 1967.

Reference is made to tools for parting rods into shorter lengths, for example the tie rods of irradiated reactor fuel stringers. Such tie rods may be many feet in length and it is necessary to reduce them into convenient lengths of for example 2 ft for handling and storage purposes. Shears are normally used for this purpose, but require frequent replacement or servicing. The tool described, for breaking a rod by repeated reversed bending, comprises a pair of clasp members adapted to grip the rod and means for oscillating one clasp relative to the other about an axis passing transversely to the length of the rod and between the clasps. In one form the tool comprises two cooperating elongated clasp members arranged in close-spaced end-to-end alignment, each having a longitudinal bore and/or other means for clasping the tie rod; the two clasp members have a pivoting interconnection, the pivot axis being transverse to their lengths, with means for oscillating one clasp relative to the other about the pivot axis to apply the bending cycles. It is convenient to mount one clasp member rigidly on a fixed mounting, the other clasp member being pivoted to the fixed mounting. The fixed clasp member may be mounted vertically on a mounting frame, and the other clasp member may be pivotally suspended from the frame below the fixed member for angular oscillation. Each clasp member may comprise a cylindrical sleeve, and either or both sleeves may be provided with remote controlled clamping means, for example a chuck, for grapping the tie rod at the end of the sleeve adjacent to the pivot axis. Several designs of chuck and actuating means are described. The tool may be mounted for horizontal movement over a fixed bed having a port leading to a disposal vault, and may carry a vertically operating lifting device to retract and replace a port sealing plug. The tool may have a base mounted in a horizontal slideway on the fixed bed. (UK)

7560 SECURING ARRANGEMENTS. Beasley, Philip Charles (to English Electric Co. Ltd.). British Patent 1,169,213. 29 Oct 1969. Filed 29 Mar 1966.

A system for securing a body against movement in a particular direction relative to a second body is useful where the second body is a plug for a reactor fuel element stringer and the first body is a tie-rod to be secured in the plug and arranged to support fuel elements extending beyond the plug. The device comprises a pluger having a jaw which is plastically deformable so to wedge the plunger in the second body in a position in which the plunger forces the first body into secure engagement with the second body in a direction perpendicular to that in which security against movement is desired. The jaw of the plunger comprises longitudinal projections arranged in a generally cylindrical configuration, open at one end so that when this end is forced radially outwards the projections undergo plastic deformation so as to assume a substantially frusto-conical configuration for engagement with a similar shaped recess in the second body. The arrangement preferably includes a withdrawable tool comprising a ram with a tapered end for engaging the inside surface of the projections, to urge them radially outwards so that they undergo plastic deformation when the end of the ram is forced into the open end of the plunger jaw. Each projection may carry a further longitudinal projection having an outer surface substantially frusto-conical in shape and tapering inwardly towards its outer end, together with a withdrawable tool comprising a second ram having a tapered coaxial mouth for engaging the outer surface of the further projections so as to force the projections back into the cylindrical configuration, thus allowing release of the plunger from the second body. (UK)

7561 WATER-WARMER USING SOLAR HEAT. Shinohara, Shigemi Japanese Patent 1969-17432. 28 Jul 1969. Filed 26 Jul 1966.

The water-warmer utilizing solar heat, proposed for its usual application, has the advantages of considerable reduction in the propagation of fungi in the tank, and softening of hard water. Accordingly, good penetration of sunlight through the tank wall is maintained, and foaming of soap is improved. The solar-heat

water-warmer is made of transparent material. Radioactive substance is attached at appropriate positions on the inside surface of the tank. Concave sections are made at suitable positions on the wall of the tank and radioactive substance is embedded in them. After embedding the radioactive substance in the concave sections, the surface may be made flush with the inside surface of the wall using a suitable filler. Uranium and its compounds may be used as the radioactive substance. (NSA of Japan)

7562 JAPAN'S NUCLEAR-POWERED COMMERCIAL SHIP MATSU. Shipbuild. Shipping Rec.; 114: 19-21(11 Jul 1969).

A description is given of the 8,250 ton gross research cargo vessel, launched in 1969, including principal particulars, general arrangement, propulsion plant, containment vessel, and radiation shields. The ship has a 36 MW indirect cycle light water reactor. (UK)

7563 SUPERCONDUCTOR MAGNET AND METHOD. Williams, J. E. C. (to United States Atomic Energy Commission). U. S. Patent 3,486,146. 23 Dec 1969.

The design of a superconducting magnet having a heat sink of high conductivity and high thermal capacity, comprising split, coaxial sleeves of cadmium, indium, or lead, in good thermal contact with a coil of superconductor ribbon interposed between the sleeves to form a cooling channel between the turns of the superconductor coil and the heat sink is described. (AEC)

7564 HYDROSTATIC EXTRUSION APPARATUS. Huddleston, R. L. (to United States Atomic Energy Commission). U. S. Patent 3,484,806. 16 Dec 1969.

In hydrostatic extrusion operations a limitation is imposed on the pressures useable in the pressure vessel due to yield strengths of the material used in the vessel construction. Technological developments have provided structures of sufficient strength to withstand radially oriented forces greater than the yield strength of the pressure vessel material but not forces imposed upon the structure which cause the innermost cylindrical member of the pressure vessel to extrude longitudinally with respect to the pressure vessel bore. To overcome this problem a variable end loading is applied against the cylindrical member by employing a selectively loaded, differential-area piston which has the smaller-area face thereof disposed against the end of the cylindrical member. (AEC)

7565 METHOD OF EXTRUSION OF RIBBED COMPOSITE MEMBERS. Levan, Roger W. (to United States Atomic Energy Commission). U. S. Patent 3,482,003. 2 Dec 1969.

A method of extruding ribbed composite members, solid or tubular, from ribbed composite billets is described. An extrusion container or liner is provided having longitudinal channels adapted to receive the longitudinal ribs on the clad surface of the ribbed billet. By applying pressure to the ribbed billet with an extrusion ram, ribbed composite members are extruded through a rib-forming die. Ribbed composite tubular members are also extruded, using a suitable mandrel, from hollow ribbed billets. The mandrel can also be provided with rib channels to extrude tubular members having interior ribs. Circumferential cladding flow and core upset are controlled by providing sufficient material in the billet rib. The method is particularly applicable to the extrusion of ribbed nuclear reactor fuel elements. (AEC)

7566 CIVIL ENGINEERING WORKS AT THE TSURUGA POWER STATION OF JAPAN ATOMIC POWER COMPANY. Manabe, Kyohei; Kajiyama, Yoshio (Japan Atomic Power Co., Tsuruga). Hatsuden Suiryoku: No. 101, 35-60(Jul 1969). (In Japanese).

The Tsuruga power station of the Japan Atomic Power Co. (JAPC) is the second commercial nuclear power station in Japan. It employs a BWR with a thermal output of 967,000 kW, and an electric output of 322,000 kW. The site includes 1,400,000 m^2 and is located on the Tsuruga cape protruding into the inlet of Tsuruga Bay, Fukui Prefecture. The reactor plant was made by G. E. of the United States. Other works, including civil engineering, was done by JAPC. The over-all construction of the power station is now in the final stage, and its trial operation, after fuel loading, is expected in the near future. The civil engineering works at the Tsuruga power station include: outline of the power station; leveling of the site and foundation works; water-intake works for steam condensers; works for water supply; works for piers; and associated works including transportation routes. (NSA of Japan)

7567 APPROXIMATE ANALYSIS OF A LARGE PRESTRESSED CONCRETE CYLINDRICAL SECTION. Derby, Roger W. (Oak Ridge National Lab., Tenn.). Nucl. Eng. Design; 10: 361-6(Jul 1969).

A straightforward procedure for calculating the radial and tangential stresses in a prestressed concrete cylindrical section is described and illustrated. A comparison with more sophisticated procedures is presented. The diminution in thermal stress due to the decrease in Young's modulus with temperature is also shown. (auth)

7568 STRESS CONCENTRATION FACTORS AROUND A PENETRATION IN A STRIP OR SLAB OF FINITE DIMENSIONS. O'Connell, J. M. (Central Electricity Generating Board, Berkeley, Eng.). Nucl. Eng. Design; 10: 356-60(Jul 1969).

Experimental and theoretical examination of the stress concentration effect of openings in pressure vessels are often carried out on rectangular slabs of finite width. The errors involved in using a penetration in a finite width slab to simulate a penetration in a much larger area were examined. Such errors are particularly critical in the examination of openings in concrete vessels due to the susceptibility of the material to cracking at relatively low values of tensile stress. (auth)

7569 HEAT EXCHANGER PLANT FOR THE EXCHANGEABLE MEDIA LIQUID-METAL/WATER. (to Interatom, Internationale Atomreaktorbau GmbH). British Patent 1,173,024. 3 Dec 1969. Priority date 31 May 1966, Germany.

A design is presented of a heat exchanger plant for liquid metal/water exchange media with one or more single or multiple heat exchanger units. It is equipped with a buffer vessel into which reaction products are channeled in the event of a failure in any part of the plant. (J.C.W.)

7570 IMPROVEMENTS IN OR RELATING TO THERMODYNAMIC ENGINES. (to N. V. Philips' Gloeilampenfabrieken). British Patent 1,175,251. 23 Dec 1969. Priority date 9 Feb 1966, Netherlands.

A thermodynamic engine is defined whereby the heat source is a mass of radioactive material arranged to give up heat developed during its decay to the working medium through the heater. Control devices are provided for maintaining the temperature at a specific value. The heat source may be placed close to the heater so as to give up part of its heat directly to the heater by conduction and/or convection and/or radiation. If the heat source is located remotely from the heater, a duct system is necessary through which a fluid heat-exchange medium can circulate to transfer heat from the radioactive mass to the heater. (J.C.W.)

7571 DC GENERATOR IN SUPERCONDUCTING CIRCUITS. Huebener, R. P. (Argonne National Lab., Ill.). Cryogenics; 9: 334-6(Oct 1969).

A generator for high direct currents in a superconducting circuit is described. It operates within a liquid helium bath by establishing a small temperature gradient across a thermoelectric alloy. The generator is very useful for energizing superconductive magnet systems. (auth) (UK)

Heat Transfer and Fluid Flow

Refer also to abstracts 7550, 7557, 7569, 7593, 8047, 8164, 8165, 8376, and 9095.

7572 (CISE-R-276) CRITICAL HEAT FLUX (CHF) PREDICTION IN COMPLEX GEOMETRIES (ANNULI AND CLUSTERS) FROM A CORRELATION DEVELOPED FOR CIRCULAR CONDUITS. Topical Report No. 71. Gaspari, G. P.; Hassid, A.; Vanoli, G. (Centro Informazioni Studi Experienze, Milan (Italy)). Jun 1968. Contract 008-61-1-NTRI. 84p. (CONF-680601-58). Dep. CFSTI (U. S. Sales Only).

From 14th Annual Meeting of the American Nuclear Society, Toronto, Ontario.

A new criterion is presented which is being developed for critical heat flux (CHF) prediction in complex geometries—with steam–water mixtures in annular-dispersed flow—starting from a correlation derived for circular conduits. Such criterion considers, at least to a certain extent, this enthalpy unbalance. The new criterion is based on the following: both in annular and clusters geometries, at given pressure, flow-rate, and geometry, the critical power ($W_{s,i}$) relevant to the surface is affected by crisis in correspondence with the boiling length, is essentially related only to the boiling length itself (L_b); and in rod bundles a tendency seems to exist for heat-transfer crisis to occur on a given rod which is not necessarily the most powered one; this is the case, for example, of the results obtained with a closely packed 19-rod bundle. This is in contrast with the correlating procedures predicting crisis to occur on the most powered rods as well as with what could be inferred from a rough subchannel analysis. From the above it seems reasonable to attribute to each heated surface a subchannel area surrounding it, to which

the correlation for circular conduits could be applied. As a boundary between the various subchannels, in analogy with some treatments made for heat-transfer analysis in single-phase flow, the locus of zero shear stress was taken. In the most interesting rod bundles an accurate prediction of the locus is very likely to be obtained by assuming it to be coincident with the line equidistant from the various solid surfaces. The round-tube correlation is described, the extrapolation to each subchannel in a cluster geometry has been made straightforward by assuming a uniform specific mass flowrate distribution over the bundle cross section. The extrapolated correlation for predicting the critical heat flux in each subchannel (i) becomes: $\hat{W}_{s,i} = G\Omega_i H_{gi} a\ (L_s/L_s + b)$, where $\hat{W}_{s,i}$ (kW) is the critical power relevant to subchannel i (in the boiling length); G (g/cm² sec) specific mass flowrate; Ω_i (cm²) cross-section area of subchannel i; $a = (1 - P/P_{cr})/(G/100)^{1/3}$; P = pressure; P_{cr} = critical pressure; H_{gi} (kjoule/g) heat of vaporization; L_s (cm) average boiling length; $b = 0.315\ ((P_{cr}/P) - 1)^{0.4} D_i^{1.4} G$; D_i (cm) equivalent diameter = $(4\Omega/\pi D_b)$; D_b = rod diameter. Equation (1) has been compared with most of the existing data giving a satisfactory accuracy. The rod affected by crisis and the critical power predictions show a ±10% RMS error in both cases, which is rather satisfactory in the whole range of investigated pressures. Work is continuing in order to optimize dependences. (auth)

7573 (EUR-4288(Vol.1)) SYMPOSIUM ON TWO PHASE FLOW DYNAMICS, EINDHOVEN, SEPTEMBER 4–9, 1967. (Technische Hogeschool, Eindhoven (Netherlands). European Atomic Energy Community). 1127p. (CONF-670912-(Vol.1)).

The proceedings of the Euratom symposium on two-phase flow dynamics held at Eindhoven, Netherlands, Sept. 4 to 9, 1967 are presented. Included in this volume are papers on single channel flow stability, flow oscillations and burnout, propagation phenomena, and physical models. (L.C.L.)

7574 (EUR-4288(Vol.2)) SYMPOSIUM ON TWO PHASE FLOW DYNAMICS, EINDHOVEN, SEPTEMBER 4–9, 1967. (Technische Hogeschool, Eindhoven (Netherlands). European Atomic Energy Community). 729p. (CONF-670912-(Vol.2)).

The proceedings of the Euratom symposium on two-phase flow dynamics held at Eindhoven, Netherlands, Sept. 4 to 9 are presented. Included in this volume are papers on parallel channel flow stability, flow regimes, component and system dynamics, and rapid transients. (L.C.L.)

7575 (EUR-4381) HEAT TRANSFER IN SMOOTH TUBES, BETWEEN PARALLEL PLATES, ALONG A SEMI-INFINITE PLATE, IN ANNULAR SPACES AND ALONG TUBE BUNDLES FOR EXPONENTIAL DISTRIBUTION OF HEAT FLUX IN FORCED, LAMINAR OR TURBULENT FLOW. Graeber, H. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 10 Mar 1969. 288p. (In German). Dep. CFSTI (U. S. Sales Only).

By introducing an additional parameter F_0, the processes known hitherto for calculating heat transfer are extended to the heat flux distributions following an exponential law $q_w = \exp(mx)$ which gives a heat transfer coefficient independent of position for laminar and turbulent flow with a linear pressure drop. For laminar flow along a semi-infinite plate, the heat flux distribution in accordance with the law $q_w = x^m$ leads to the Nusselt number, regardless of the position. Nu is then determined by the thickness of the thermal boundary layer. With an approximation process it is possible to calculate the thickness of this thermal boundary layer and then the Nusselt number, defined by the distance x from the front edge of the plate. For the annular space, the equations for explicit calculation of the temperature field will be given as well as the Nusselt number in laminar flow and constant heat flux, the heat transfer taking place on one wall or both. In turbulent flow the laws of distribution of eddy diffusivity for momentum in a tube, established by H. Reichardt, adapted for the annular space and the tube bundle give the velocity field and the coefficient of friction and thus permit solution of the heat transfer equations. The results of the numerical calculation are given in the tables and diagrams for an extended range of the various parameters and are compared with the experimental results: distribution of velocity, temperature and heat flux density normal to the wall, Nusselt number and mean temperature. A simple process to determine the lower limit of the thermal entry length is described. (auth)

7576 (EURFNR-664) THE INFLUENCE OF GEOMETRICALLY DEFINED ROUGHNESS ON HEAT TRANSFER AND PRESSURE DROP IN AXIAL-FLOW SEVEN-ROD CLUSTERS. Casal, V.; Waggott, R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). Translation of report KFK-806. 61p. Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 47693. (J.C.W.)

7577 (ORNL-4458) NUMERICAL EVALUATION OF THE VELOCITY AND TEMPERATURE STRUCTURE IN LAMINAR CELLULAR CONVECTION BETWEEN PARALLEL RIGID SURFACES. Wantland, J. L. (Oak Ridge National Lab., Tenn.). Dec. 1969. Contract W-7405-eng-26. 204p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee [Knoxville].

It was desired to determine the velocity and temperature structure for laminar cellular convection (Bénard cells) of a viscous fluid between rigid parallel horizontal surfaces across which an adverse temperature difference is maintained. Experimental measurements are difficult to make and the equations of motion are not amenable to generalized analytical solutions, therefore a numerical attack was made using different forms of the controlling equations in a digital computer program. Since the detailed solutions of completely three-dimensional problems are beyond the capabilities of contemporary computers, a single hexagonal Bénard cell is idealized as consisting of a vertically oriented right circular with two-dimensional axisymmetric flow. The fluid is assumed to be Newtonian and the Boussinesq approximation is used in the full Navier–Stokes equations. The numerical technique is based on the MAC method developed at the Los Alamos Scientific Laboratory. For prescribed values of the Rayleigh number (N_{Ra}, a dimensionless temperature difference) and the cylinder diameter-to-height ratio (D/H), the program provides tables of the horizontal and vertical velocity components and the temperature field (in dimensionless forms). The horizontally averaged vertical temperature profile and the Nusselt number (N_{Nu}, a dimensionless heat flux) are also computed. Although transient results can be obtained, only steady-state values are reported. The maximum velocity was found to be the vertical velocity on the centerline and slightly above mid-height. The maximum velocity can be expressed by the equations $N_{Ra} < \sim 4700$, $v_{max} = 0.433\ \nu/H\ (N_{Ra} - 1795)^{1/2}$; and $N_{Ra} > \sim 4700$, $v_{max} = 0.180\ \nu/H\ (N_{Ra} - 1795)^{0.61}$. For $N_{Pr} = 1$ and $2800 \leq N_{Ra} \leq 35{,}000$, the Nusselt number was determined as a function of D/H. The value of D/H which gives the maximum Nusselt number was found to vary significantly from the value of 2.0 previously used: from 2.6 at $N_{Ra} = 2800$ to 2.2 at $N_{Ra} = 35{,}000$. However, the ratio of the maximum Nusselt number to that obtained with D/H = 2.0 varies by less than six percent. This ratio is 1.056 at $N_{Ra} = 2800$ and 1.002 at $N_{Ra} = 35{,}000$. (auth)

7578 (SU-247-15) RADIATION AND NONEQUILIBRIUM EFFECTS ON HEAT TRANSFER FROM A PLASMA IN TUBE FLOW. Hunn, Bruce D. (Stanford Univ., Calif. Dept. of Mechanical Engineering). Oct 1969. Contract AT(04-3)-247. 43p. Dep. CFSTI.

The effects of radiation and nonequilibrium on heat transfer from a partially ionized argon plasma flowing through a water-cooled tube were investigated. These effects are especially significant in the entrance region. Preliminary work toward the adaptation of the Apalding–Patankar finite-difference computing scheme to plasma flows is discussed. A model to predict the radiative heat flux to the wall is proposed for inclusion in this finite-difference program. Calculations for typical temperature nonequilibrium conditions are made and it is concluded that elevated electron temperature at the tube wall will not significantly affect the radiative heat transfer. Absorption of radiation by the plasma is considered as it relates to the proposed radiation model. A proposed experiment to measure the radiative flux to the tube wall is outlined and recent modifications to the experimental apparatus are presented. (auth)

7579 (WCAP-2670) HYDRODYNAMIC ASPECTS OF CROSS-FLOW TO CYLINDRICAL RODS. Larsen, P. S. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Aug 1964. 27p.

The literature pertaining to flow patterns, drag, lift, and induced oscillations for circular cylindrical rods in cross flow has been reviewed to provide a background for further analysis and study of such problems. (auth)

7580 (WERL-1114-4) FINITE ELEMENT ANALYSIS OF HEAT CONDUCTION IN ANISOTROPIC SOLIDS (LWBR Development Program). Visser, C. (Westinghouse Research Labs., Pittsburgh, Pa.). 29 Jul 1968. Contract AT-11-1-GEN-14. 64p. Dep. CFSTI.

For Bettis Atomic Power Lab., Pittsburgh, Pa.

Element matrices and vectors are derived for the finite element analysis of heat conduction problems under steady-state as well as transient conditions. Both plane and axisymmetric problems are considered. The necessary theory for the development of finite element heat conduction programs is summarized. (auth)

7581 (ZJE-57) HEAT TRANSFER IN FINNED ROD CLUSTERS WITH AXIAL FLOW. Krett, V. (Skoda Concern, Pilsen (Czechoslovakia). Nuclear Power Plants Div.). Nov 1969. 11p. Dep. CFSTI (U. S. Sales Only).

An account is given of the experimental equipment, methods of measurement and evaluation of the coefficient of friction, and the heat transfer coefficient on bundles of finned rods. Taking the conceptional possibilities of the HWGCR fuel elements into account the following two types of finned rods were used: the first type with 3 higher fins without any spacers and the second type with 12 and 15 lower fins with spacers. The results of measurements are given in non-dimensional criteria dependent on geometrical characteristics of the bundles. The experiments were carried out on air loops in the range $Re = 0.4 \times 10^5$ and 2×10^5. (auth)

7582 EXPERIMENTAL EXAMINATION OF THE ANALOGY BETWEEN CONVECTIVE HEAT AND MASS TRANSFER AT A HERRINGBONE FINNED TUBE. Presser, K. H. (Kernforschungsanlage, Juelich, Ger.). Chem.-Ing.-Tech.; 41: 1176-81(Nov 1969). (In German).

Herringbone finned tubes manufactured from a magnesium–zirconium alloy are used for the cladding of cylindrical uranium rods in French and English power reactors of the natural-uranium–graphite–gas-type. Heat transfer coefficients at constant heat transfer per unit area and constant internal wall temperature with Prandtl numbers of 0.7 to 0.8, and mass transfer coefficients at constant partial pressure at the finned surface for a Schmidt number of 2.53 were measured at a herringbone finned tube in the system naphthalene–air. (auth)

7583 VIBRATION OF CONTAINING STRUCTURES BY SOUND IN THE CONTAINED FLUID. Fahy, F. J. (Univ. of Southampton, Eng.). J. Eng. Ind.; 91: 939-50(Nov 1969).

A system which consists of a rigid rectangular box with one simply supported flexible wall was analyzed by numerical and statistical methods for the internal acoustostructural mode coupling factors and the corresponding modal average radiation efficiency. It was found that for subcritical frequencies, but above a frequency which corresponds to the lower limit for maximum proximate mode coupling, the radiation efficiency was equal to that of a baffled panel radiating into a free field. At supercritical frequencies a value of radiation efficiency half that of a freely radiating panel was found. Below the limiting frequency an approximate dependence upon $(f/f_c)^2$ was found experimentally in all cases. The same type of behavior has been observed with an internally excited, partially closed cylinder. The radiation efficiency of a clamped panel was calculated to be about 3 db greater than that of the simply supported panel at low frequencies. This factor falls to zero at the critical frequency and above. Corrections to the normal statistical energy response and radiation equations are presented which take into account the fact that it may not be assumed, purely on the basis of modal density ratio considerations, that many acoustic modes couple with an individual structural mode. (auth)

7584 INCIPIENT-BOILING WALL SUPERHEATS IN LIQUID METALS. Dwyer, O. E. (Brookhaven National Lab., Upton, N. Y.). Int. J. Heat Mass Transfer; 1403-19(Nov 1969).

It is shown that good agreement between predicted and measured incipient-boiling wall superheats can be obtained with Holtz's original superheat model, if two additional factors are taken into consideration. The first of these is the loss of inert gas from the cavity between the time of maximum boiling suppression (MBS) and the time of the incipient boiling (IB) event. The second is the probability that the radius of curvature of the liquid-vapor interface at IB may be significantly different from that at MBS. From the recent experimental IB results obtained by Chen on potassium and those obtained by Holtz and Singer on sodium, the following tentative conclusions were drawn. The loss of inert gas from an active cavity between the time of MBS and that of the first IB event appears to be negligibly small, but it can be considerable if a large number of IB events follow a single MBS treatment. Bubble radius at IB is about $\frac{2}{3}$ that at MBS. Surface finish for standard smooth surfaces does not appear to have a strong influence on IB superheats. The apparent heat-flux effect could possibly be in reality an inert-gas effect. (auth) (UK)

Isotope Technology

Refer also to abstracts 7502, 7520, 7570, 7640, and 8782.

7585 (AI-AEC-12895) LARGE RADIOISOTOPE HEAT SOURCE CAPSULE (LRHSC). Ninth Quarterly Progress Report, July 1–September 30, 1969. (Atomics International, Canoga Park, Calif.). 15 Nov 1969. Contract AT(29-2)-2338. 65p. Dep. CFSTI.

The tantalum alloy isotopic fuel capsule, developed under the Large Radioisotope Heat Source Capsule (LRHSC) Program for providing a capsule capable of operation in space at a surface temperature of 2000°F for five years, was selected for use in the Transit Program. Therefore, the LRHSC Program was divided into two tasks—the high temperature capsule technology program and the development of the fuel Capsule for Transit TRG. In the former task, program planning is on schedule; drawings have been revised; six T-111 capsule shells were fabricated of which 2 were assembled into impact capsules and a third used in an internally heated capsule assembly; a process specification for arc plasma spraying of Al_2O_3 on the T-111 shell was written; creep testing of the capsules continued; two capsules were impact tested and found to be leak tight; the development and fabrication of Transit-sized vented capsules is proceeding; and no Pt-20Rh was available for the barrier shell tooling studies. In the second task, the program plan and time schedule for developing and testing the refractory and noble metal components for the TRANSIT capsule are given. (L.C.L.)

7586 (CEA-R-3843) PROGRAMMING AND DETECTION OF ACTIVITY IN AN ON-LINE ISOTOPE SEPARATION COLLECTOR. Crancon, Jean; Guisset, Michel; Ristori, Christian (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Aug 1969. 19p. (In French). Dep. CFSTI (U. S. Sales Only).

A device for programming irradiation, counting, and printing times, to be used connected with on-line isotopic separation studies is described. On the other hand a fast mechanical transporting aluminum ribbon has been used to transfer the collected activity to the low background counting place. The working parameters can be adjusted to short half-lives (down to a few seconds) as well as for neutron-induced U fission yields. (auth)

7587 (MMM-3691-57) SNAP-21 PROGRAM, PHASE II, DEEP SEA RADIOISOTOPE-FUELED THERMOELECTRIC GENERATOR POWER SUPPLY SYSTEM. Quarterly Report No. 13, July 1–September 30, 1969. (Minnesota Mining and Mfg. Co., St. Paul. Electrical Products Group). Contract AT(30-1)-3691. 119p. Dep. CFSTI.

The final safety analysis report is included. The hydrostatic testing of System S10P4 was completed, along with the thermal and electrical characterization. The long-term testing of S10P4 was begun. System S10P3 was implanted off San Clemente Island. Phase I and II thermoelectric generators will continue to be tested. The conceptual design of the 20-watt system was completed and the selected configuration is a strontium oxide-fueled single generator that is basically a scaled-up 10-watt system. A drawing of the selected system is given. (J.C.W.)

7588 (MMM-3824-40) SNAP-23A PROGRAM, PHASE I. THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM. Quarterly Report No. 11, July 1, 1969–September 30, 1969. (Minnesota Mining and Mfg. Co., St. Paul). 31 Oct 1969. Contract AT(30-1)-3824. 142p. Dep. CFSTI.

Design analysis and development continued during fabrication and assembly of the SNAP-23A 60-watt converter PMC-2. Working drawings were issued and used for development work, manufacturing planning, and quality control planning. Converter performance was re-evaluated at EOL design conditions. The completion of the Fire Safety Design was finalized and submitted to the AEC. The design details of the six-couple test module were completed and piece-parts are being either processed or fabricated. Long term operation and testing continued on the 10-couple modules, and converters 23P2, EMC-2, EMC-3 and PMC-1B. (J.C.W.)

7589 (ORNL-IIC-22(Pt.3)) SELECTED ABSTRACTS OF WORLD LITERATURE ON PRODUCTION AND INDUSTRIAL USES OF RADIOISOTOPES (FROM NSA JULY–SEPTEMBER 1969). Gerrard, Martha; Baker, P. S. (Oak Ridge National Lab., Tenn.). Dec 1969. Contract W-7405-eng-26. 49p. Dep. CFSTI.

Approximately 450 abstracts of domestic and foreign publications on production and use of radioisotopes and radiation, selected from the July to September 1969 issues of Nuclear Science Abstracts, are presented. (auth)

7590 (ORNL-TM-2807) RADIOISOTOPE PROGRAM (8000) PROGRESS REPORT, OCTOBER 1–NOVEMBER 30, 1969. Rupp, A. F. (Oak Ridge National Lab., Tenn.). Dec 1969. Contract W-7405-eng-26. 48p. Dep. CFSTI.

Developments are reported for: radioisotope production, including neutron products, cyclotron products, fission products, and radiation sources; radioisotope source safety testing; technology utilization; radioisotope applications, including basic technology and systems engineering applications; radiation pro-

cessing applications; and radioisotope sales. Papers reviewed and published in the information center are listed. Developments are also given on the RIST program to determine volume of sediment transport. A list of radioisotope sales and shipments is also included. (J.C.W.)

7591 (ORO-662) EVALUATION OF A HIGH SPECIFIC ACTIVITY ^{60}Co SOURCE USED IN A GAMMA MONOCHROMETER. McIntyre, John A. (Texas Agriculture and Mechanical Univ., College Station. Research Foundation). 25 May 1969. Contract AT(40-1)-3410. 18p. Dep. CFSTI.

A 40,000 curie cobalt-60 source in a gamma monochromator was evaluated. The 1.33 and 1.17 MeV gamma radiation leaving the source scatter from the scatterer by the Compton scattering process. Two types of research have been pursued using this variable-energy gamma beam. The gamma radiation was used to excite nuclear energy levels through the resonance fluorescence process. The character of the gamma radiation produced by the Compton scattering process was studied. The target was removed and a Ge(Li) solid state detector was put in its place. The pulse height distribution of the detector then yielded the energy distribution of the scattered gamma radiation. A description of the source and container is given. (J.C.W.)

7592 (SC-PR-69-672) AEROSPACE NUCLEAR SAFETY PROGRAM. Sandia Laboratories Quarterly Report, July 1–September 30, 1969. Illing, R. G. (comp.) (Sandia Labs., Albuquerque, N. Mex.). Oct 1969. 30p. Dep. CFSTI.

Drop test results for the Pioneer radioisotope thermoelectric generator are reported along with first phase results of Transit solid propellant burn tests. Work on advanced fuel safety is reported on reentry ablation, aerothermal analysis, similarity analysis, and material properties. The feasibility of simulating Transit capsule reentry under abort conditions was studied. Factors involved in rocket mission abort were studied to establish a basis for an abort model. (J.R.D.)

7593 (TID-25177) DISCHARGE MEASUREMENTS USING RADIOISOTOPES IN HIGH-HEAD TURBINES AND PUMPS AT FLATIRON POWER AND PUMPING PLANT COLORADO: BIG THOMPSON PROJECT. General Report No. 40. Schuster, J. C.; Hansen, R. L. (Division of Research (AEC), Washington, D. C. Bureau of Reclamation, Denver, Colo. Office of Chief Engineer). Dec 1968. 171p. Dep. CFSTI.

Techniques and equipment are being developed to improve methods for measuring flow rate in high-head turbines and pumps. A series of discharge measurements was begun in 1967, at Flatiron Powerplant near Loveland, Colo., to evaluate techniques and equipment developed in preliminary investigations of the use of radioactive material. Measurements were made on a 6000-ft-long, 6-ft-dia penstock and on a 6000-ft-long, 8-ft-dia pump discharge line. Thirty-five injections of radioactive bromine-82 were made in the penstock, and 12 injections were made in the pumpline. Ninety-three discharge values were computed for penstock flows and 29 for pumpline flows. Mixing lengths ranged from 47 to 755 diameters; discharge ranged from about 130 to 300 cfs. The measurements gave good information on length of pipe required for natural turbulence to mix pipe flow and tracer and for additional mixing caused by a pump. Discharge measurements on the turbine and pump were not as precise as desired but were encouraging. (auth)

7594 ISOTOPE POWERED PHOTOVOLTAIC DEVICE. Wagle, Joseph A. (to General Motors Corp.). U. S. Patent 3,483,037. 9 Dec 1969. Filed 16 Dec 1965.

A radiant energy conversion device includes a pair of interconnected evacuated spheres. One carries an array of photovoltaic cells concentric with a radiant body. Heat is supplied to the radiant body from a mass of radioactive isotopes in the other sphere through a mass of graphite. Thermal insulation and biological shielding are provided around the isotope mass. (Offic. Gaz.)

7595 NUCLEAR BATTERY INCLUDING PHOTOCELL MEANS. Parkins, William E. (to North American Rockwell Corp.). U. S. Patent 3,483,040. 9 Dec 1969. Filed 27 Jun 1966.

A nuclear battery or electrical power supply is described that uses a radioactive source whose radiation is converted to electromagnetic radiation by a fluorescent gas, which is then converted to electrical energy in photocells such as photoelectric or photovoltaic cells. (Offic. Gaz.)

7596 MEANS AND METHOD FOR ENCAPSULATING MATERIAL FOR RADIATION. Fitzgerald, Joseph James; Brownell, Gordon Lee (to Cambridge Nuclear Corp.). British Patent 1,168,282. 22 Oct 1969. Filed 24 Apr 1967.

Cold encapsulated radioactive heat sources are described and advantages of cold compared with hot (radioactive) encapsulation are outlined. The method of preparation comprises preparing a wafer of non-radioactive thulium oxide by compressing and sintering particles of thulium oxide, placing the wafer in a Mo capsule, joining the wafer to the capsule walls, sealing the capsule, and subjecting the oxide to a neutron flux of at least 10^{14} n/cm^2/sec for 35 to 150 days, thus producing ^{170}Tm or ^{171}Tm. The specific activity of such a ^{170}Tm source is of the order of 5 to 15 W/cc or for ^{171}Tm of the order of 0.5 to 1.5 W/cc. For ^{171}Tm the neutron flux should be at least 10^{15} n/cm^2/sec. Zr or W may also be used for the capsule material. (UK)

7597 POSSIBILITIES AND LIMITS OF RADIOACTIVE LABELLING IN MACHINING STUDIES. Scheffler, G. Isotopenpraxis, 5: 234-6(June 1969). (In German).

Busching proposed a method for the measurement of the wear behavior of the cutting materials under machining conditions. A cutting tool permanently makes a new metallically pure surface. With a labeling of the surface during the grinding test, the material loss in the chips of the cutting material could be easily measured. The method was tested on the study of the effect of surface layers on the wear behavior. Sintered tungsten carbide surfaces were used in which the layers were enriched in ^{187}W. The results obtained were illustrated and discussed. It was shown that the radioactive measurement method yields an increase in the accuracy and sensitivity to the method proposed by Busching. (J.S.R.)

7598 RADIOISOTOPE DIRECTORY. Nucl. News; 12: No. 12, 1-44(Dec 1969).

An alphabetical listing of 163 radioisotopes that are covered in the Radioisotope Product Directory is presented. For each listed radioisotope, the chemical symbol, half-life, decay mode(s), decay energy(ies), and abundances (%) are given as well as the companies that supply the radioisotope. In addition to listing the companies that supply a particular radioisotope, the Directory also indicates, for each company, the forms in which the radioisotope is available from that company. The company directory section lists in alphabetical order the companies represented in the Radioisotope Product Directory. Code numbers appearing in the company listing indicate whether or not the company fabricates special sources, offers specialty sources, and if a product catalog is available. A section on radioisotope license requirements gives an alphabetical listing of the states which have assumed the responsibility of controlling the distribution, handling, and use of radioactive materials. Each listing gives the address from which a customer may procure the license necessary to obtain radioactive material from a supplier. (auth)

7599 SUBSEA NUCLEAR POWER CONTROLS WELLHEAD. Drilling; 29: 64-5(Jul 1968).

The first nuclear-powered, acoustically controlled sub-sea wellhead is in operation in 92 feet of water in the Gulf of Mexico. The system includes a conventional Christmas tree. Mounted on the guide base are two small radioisotopic generators furnishing 3 watts of uninterrupted electric power. The thermoelectric generators are fueled with ^{90}Sr. The power output of this generator meets the peak-loads required to open and close the four 2-inch valves on the Sinclair tree. A conditioning device stores the excess power in a storage battery. Electromechanical operations actuate the valves. (J.C.W.)

Materials Testing

Refer also to abstracts 7551, 7567, 7568, 7589, 8044, 8132, 8215, and 8790.

7600 (BNWL-1273) ELECTRO-THERMAL NONDESTRUCTIVE TESTING METHOD. Green, D. R.; McCullough, L. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec 1969. Contract AT(45-1)-1830. 7p. Dep. CFSTI.

A nondestructive testing technique capable of detecting flaws in metals has been developed. This technique uses electrical heating in conjunction with infrared mapping of surface temperatures. It has been demonstrated on steel bars having 1/16 in. diameter holes drilled at a depth of approximately 0.146 in. under the surface. (auth)

7601 (NP-tr-1867) BETA AND GAMMA AUTORADIOGRAPHY OF IRRADIATED NUCLEAR FUEL. Marsico, B.; Trezza, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Translated by W. G. Stripp (Atomic Energy Research Establishment, Harwell, Eng.), from report RT/CHI-(69)5. 9p. Dep. CFSTI (U. S. Sales Only).

An abstract of this paper, prepared from the original language, appeared as NSA 23: 36224.

7602 (PB-184359) IN-SERVICE INSPECTION PROGRAM FOR NUCLEAR REACTOR VESSELS. Biannual Progress Report No. 1, December 1, 1968–March 1, 1969. Wylie, Robert D. (South-

west Research Inst., San Antonio, Tex. Edison Electric Inst. [New York]. Tennessee Valley Authority, Knoxville). 2 Jun 1969. 76p. CFSTI.

A summary is given of the work performed on the six separate projects. A review of recent utility experience with power reactor coolant pressure boundary inspection regarding service condition, defect detection capability, defect size, and defect orientation; development of a nondestructive test method evaluation facility; investigation of the acoustic spectrometer as a semi- or fully-continuous scanning method; investigation of acoustic emission techniques for continuous monitoring; improvement in reliability and reproducibility of conventional ultrasonic systems for reactor inspection; and information collection, reporting, and dissemination are discussed. (USGRDR)

7603 SELF-STABILIZING PORTABLE PROBE FOR MEASURING THICKNESS UTILIZING RADIATION. Joffe, Boris B.; Tiebor, John E. (to Twin City Testing Corp.). U. S. Patent 3,483,382. 9 Dec 1969. Filed 23 Dec 1965.

A self stabilizing portable probe is described that has a surface engaging side wall with an exposure opening in it. A radiation source mounted on the housing is aligned with the opening for transmitting radiation against a test area. A radiation detector carried by the housing has a radiation receiving window aligned with the exposure opening for receiving backscatter radiation from a test area through the opening. The housing side wall supports and stabilizes the probe with the opening in abutting relation with the test area. (Offic. Gaz.)

7604 YOUR OWN PERSONAL NEUTRON RADIOGRAPHY SET. Barton, John P.; Klozar, Melvin F. (Argonne National Lab., Ill.). Mater. Eval.; 27: 12A(Dec 1969).

A description is given of a 140 microgram neutron source of californium-252 for use in inexpensive industrial radiography. (J.C.W.)

7605 BETA-RAY MEASURING PROBE AND ALIGNMENT STRUCTURE. Joffe, Boris B.; Tiebor, John E. (to Twin City Testing Corp.). U. S. Patent 3,483,375. 9 Sep 1969. Filed 23 Dec 1965.

A head at one end of an arm contains a radiation emitting source and a radiation detector, the head having a cover receiving interchangeable platens. An alinement support block extends from the arm in spaced relation to the head, the block engaging a supporting surface for maintaining the platen in abutting relation with the area under test. The block provides stable support on curved as well as flat surfaces, and is adjustable relative to the arm for varying the height of the arm above the support surface. (Offic. Gaz.)

Radioactive Material Handling

Refer also to abstract 7589.

7606 (AECL-3429) DESIGN FEATURES IMPORTANT IN THE SAFE HANDLING OF RADIOACTIVE MATERIALS IN THE "HOT" FACILITIES AT ORNL. Bainbridge, F. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Sep 1969. 15p. (CONF-691008-3; SM-125/9). Dep. CFSTI (U.S. Sales Only). AECL $0.50.

From Symposium on Radiation Safety Problems in the Design and Operation of "Hot" Facilities, Saclay, France.

The hot cell facility consists of three cells; two of the cells have a common shielding wall and are used to handle ^{60}Co and 50 cm fuel bundles; the third cell, 500 cm long, is used to examine fuel elements and assemblies 300 to 400 cm long. Up to 100,000 curies of ^{60}Co have been moved in single transfers and fully irradiated fuel strings containing many thousands of curies of fission products are handled routinely. The rear doors of the cells provide an opening up to 200 cm square through which flasks, weighing up to five tons, can be transferred into an isolation room. The room is vented into the cell and acts as a buffer between the cell and the operating area to prevent the spread of radioactive contamination. Radioactive material can also be transferred into the cells through 7.5 cm square ports in the walls. When not in use the ports are sealed by lead gates. The ports have been improved by recessing them into the wall and by changing the gate-drive mechanism to allow maintenance from the cold side of the cell. (auth)

7607 (ARH-SA-48) NEW PLUTONIUM BUTTON STORAGE ARRANGEMENT. Ridgway, K. R. (Atlantic Richfield Hanford Co., Richland, Wash.). 31 Oct 1969. 13p. (CONF-681102-3). Dep. CFSTI.

From 10th Liquid Propulsion Symposium, Las Vegas, Nev.

The largest known storage array of plutonium metal buttons was assembled at Hanford, Washington. The Monte Carlo code Gem III was used to determine the safe array. However, the array size was actually limited by potentially high neutron levels from multiplication and spontaneous fission. Neutron counting during the array assembly verified the subcriticality of the array and defined the actual radiation level. The 24- × 11- × 9-ft vault arrangement was based upon button accessibility, maximum button storage with acceptable radiation levels, and minimum cost. The 1092 button array consisted of three double rows running lengthwise with the following spacing: 24 in. between the double rows, 12 in. between buttons in the double rows, and lengthwise and vertical button spacing of 9 and 12 in., respectively. Calculations for lengthwise button spacings of 9 in. indicated a critical array of 2200 215-kg buttons. This agreed closely with extrapolated measured data on neutron counts and radiation dose rates taken during the vault loading and which resulted in an indicated critical array of greater than 2600 2.1-kg buttons. (L.C.L.)

7608 (BNWL-1196) AN EVALUATION OF PREDICTIVE METHODS OF DETERMINING THE EFFECTS OF SOLID-LIQUID PHASE INTERACTIONS ON THE MOVEMENT OF SOLUTES IN SOILS. Routson, R. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov 1969. Contract AT(45-1)-1830. 14p. Dep. CFSTI.

An evaluation was made of the available methods, theories, and models which have been used to describe solid-liquid phase interactions that take place in porous media. Only the discontinuous-fixed plate model of Dutt was found to be a multion approach which prior work on the Hanford project has shown to be necessary for a successful sorption description. The combination of Dutt's macroion approach and an empirical-statistical method of measuring trace radionuclide sorption was deemed to be the most fruitful approach for describing radionuclide concentration as a function of position and time. A computer program has been written and experiments have been designed to measure model parameters for testing the aforementioned approach. (auth)

7609 (BNWL-1233) RADIOLOGICAL STATUS OF THE GROUND WATER BENEATH THE HANFORD PROJECT, JANUARY-JUNE 1969. Denham, D. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov 1969. Contract AT(45-1)-1830. 20p. Dep. CFSTI.

An evaluation of data collected during the first six months of 1969 on ground water contamination resulting from the disposal of Hanford Project plant effluents is presented. The ^{106}Ru and ^{3}H concentrations measured in the unconfined ground water showed that the zones of detectable contamination extend in a southeasterly direction from 200-E (chemical processing) Area as observed in the past. The few locations from which ground water samples exceeded the concentration guides (CG) for ^{106}Ru were all within either the 200-E or 200-W (chemical processing) Areas. Only one well (No. 699-35-70) located outside the 200 Area fences indicated a ^{3}H concentration greater than its CG. The highest-average measured concentration of ^{51}Cr in unconfined ground water within or near the 100 (production reactor) Areas (Well 199B-5-1) was less than 5% of the CG for ^{51}Cr (2000 pCi/ml). Primarily uranium was observed in 300 (fuel fabrication and laboratory) Area ground water at average concentrations below 0.5 pCi/ml (<3% CG). No total beta concentrations were detected during this time in any confined ground water aquifers. The highest average ^{3}H concentration observed in a confined ground water zone was 360 pCi/ml (12% CG for ^{3}H) from Well 699-42-42-P. Much of the area surrounding the 200 Area disposal sites is contaminated with nitrates. Some nitrate ion (NO_3^-) concentrations were above the Public Health Service recommended drinking water limit of 45 ppm, especially around the disposal sites and the 300 Area. However, none of the ground water from these contaminated areas is being consumed by humans or is used for irrigation or consumption by cattle. (L.C.L.)

7610 (EUR-4382) NUCLEAR SAFETY FOR THE TRANSPORT CASK FOR ENRICHED FUEL ELEMENTS IRRADIATED IN ESSOR. Ricchena, R.; Rocco, P. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1 Apr 1969. 32p. (In French). Dep. CFSTI (U. S. Sales Only).

Criticality calculations for the transport cask of the enriched fuel elements irradiated in the ESSOR reactor are presented. The safety criteria of the calculations comply with the IAEA Regulations. Calculative hypotheses are the ones normally used to evaluate the reactivity of fissile assemblies, completed with other hypotheses coming from the experience of the nuclear safety problems. A first verification was done with the multigroup transport theory. The computation was carried out with the DTF Code on the IBM-360 computer, using 16 velocity groups, and the set of microscopic cross sections of Hansen and Roach. A second verification was made according to the two-groups method, with band calculation of the K_{eff} and evaluation of the microscopic cross section on the ef-

fective neutron spectrum of equilibrium. This computation was made with the codes GAM-II and GATHER-II. The results of the two verifications agree and show the safety of the assembly in the accident conditions imposed by the Regulations. Moreover, an additional calculation was made to control the variation of reactivity for an increase of the pitch and diameter of the element housings. It is shown that as a consequence of this modification, the reactivity of the system decreases. (auth) (EURATOM)

7611 (LA-4315) NUCLEAR SAFEGUARDS RESEARCH AND DEVELOPMENT. Program Status Report, July-September 1969. Keepin, G. Robert (ed.) (Los Alamos Scientific Lab., N. Mex.). 21 Nov 1969. Contract W-7405-eng-36. 27p. Dep. CFSTI.

Methods for the nondestructive assay of fissionable materials include neutron self-indication, prompt fission neutron assay of fissionable materials, californium-252 source, and delayed neutron assay of inventory samples and fissionable scrap. Passive and auxiliary assay techniques are discussed. The parameters of the delayed neutron yield-vs-energy measurements and delayed neutron abundances and half-lives in 14.9-MeV fission are given. The neutron detector development and the mobile nondestructive assay laboratory are described. Accelerators, neutron sources, and facility development for the nuclear safeguards research and development are discussed. (J.C.W.)

7612 (ORNL-TM-2677) MANAGEMENT OF NOBLE-GAS FISSION-PRODUCT WASTES FROM REPROCESSING SPENT FUELS. Blomeke, J. O.; Perona, J. J. (Oak Ridge National Lab., Tenn.). 21 Nov 1969. Contract W-7405-eng-26. 22p. Dep. CFSTI.

Technology is presently available for removal of krypton and xenon, and after they have been separated, it is proposed that the krypton be compressed in standard gas cylinders (either mixed with xenon, or after having been separated from it), and shipped to a salt-mine repository for permanent storage. A plant reprocessing 2800 tons/year of fuel would produce only 28 50-liter gas cylinders per year of krypton, each containing about a million curies of ^{85}Kr and generating about 5800 Btu of heat per hour. If the krypton and xenon were not separated from each other, 160 cylinders/year would be produced, each containing 180,000 curies of ^{85}Kr and generating heat at a rate of 1000 Btu/hr. The pressurized gas cylinders could be stored temporarily at the plant in water-filled canals, and then shipped to a salt mine in specially-designed casks containing from one to five cylinders each. The carbon-steel cylinders should last many decades, and the mine space required would be only about 1 to 2% of that required for storage of solidified high-level wastes. The cost of noble-gas management by this method, exclusive of the cost of separating the gases from the plant's process off-gas, is estimated to range from $190,000 to $220,000 per year. This corresponds to 0.0003 to 0.00035 mills/kWhr of electricity originally produced from the fuel. (auth)

7613 (RFP-1347) DISPOSAL OF CONTAMINATED LITHIUM-METAL SCRAP. Ziegler, Donald L. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 19 Sep 1969. Contract AT-(29-1)-1106. 7p. Dep. CFSTI.

Two methods of disposal for plutonium contaminated lithium scrap were explored that consisted of reacting lithium metal with water saturated xylene forming the lithium hydroxide precipitate, and reacting lithium with butanol forming the alkoxide which was hydrolized with water. The second method was found more attractive for laboratory scale disposal and was scaled up to a size suitable for reacting 500 grams of lithium per batch. One and one half kilograms of lithium turnings and 31 liters of lithium-contaminated oil were disposed of by this method. One major problem arose with this process. If the agitation was insufficient, the metal underwent a rapid reaction with the evolution of a large amount of white vapor. Identification of this reaction and the composition of the white vapor could not be made. (auth)

7614 (RT/PROT-(69)21) CLASSIFICATION OF INDUSTRIAL RADIOACTIVE WASTES. Branca, G.; Gera, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1969. 19p. (In Italian). (CONF-690328-1). Dep. CFSTI (U. S. Sales Only).

From 4th Conference of the National Society of Sanitary Engineers, Milan, Italy.

Some general considerations on the classification of conventional wastes were developed and the classification standards of radioactive wastes in many countries are reported. The large differences and variability of wastes characteristics make rather doubtful the first choices of the classification parameters. Furthermore, even if the same parameters are selected, the comparison among the various classifications is rather uncertain on account of the different ranges adopted for the categories. Consequently the information exchange and the comparison of the technical and economical data concerning the treatments under examination are difficult. After a review of the most important parameters, a new classification of liquid and gaseous radioactive wastes is proposed. Both the intrinsic dangers of the wastes and the implications connected with the environment are taken into account. (auth)

7615 (STI/DOC-10/83) ECONOMICS IN MANAGING RADIOACTIVE WASTES. Report Resulting from Two Panels of Experts on the Economics of Radioactive Waste Management. Technical Reports Series No. 83. (International Atomic Energy Agency, Vienna (Austria)). Apr 1968. 46p. IAEA $1.00.

The deliberations of a panel of experts convened by the IAEA from 13 to 17 December 1965 and again from 17 to 21 October 1966 are reported and include discussions of the following subjects: definition of waste management; the effects of various factors on waste management costs; recommended cost-reporting system; setting up a costing system; and analysis of waste management costs submitted to the panel. Sample IAEA recommended cost-analysis reports for radioactive waste management and two hypothetical examples of the costing system are included as appendixes. (auth)

7616 (STI/PUB-208) MANAGEMENT OF RADIOACTIVE WASTES AT NUCLEAR POWER PLANTS. Safety Series No. 28. (International Atomic Energy Agency, Vienna (Austria)). Dec 1968. 225p. IAEA $6.00.

Design data and operating experience with waste-management systems at nuclear power stations in Canada, France, the United Kingdom, and the United States are described. The factors which must be considered in nuclear power plant waste management are discussed and include: waste sources and characteristics; safety standards and radiation dose limitations; in-plant and off-site environments; waste treatment capabilities; and performance verification and monitoring requirements. The operating experience with the different waste-management systems in each country has been uniformly excellent in maintaining the radiation exposure in the environment well below the accepted dose standards. (L.C.L.)

7617 (WASH-1143) LAND BURIAL OF SOLID RADIOACTIVE WASTES: STUDY OF COMMERCIAL OPERATIONS AND FACILITIES. Morton, Roy J. (Division of Reactor Development and Technology (AEC), Washington, D. C. Environmental and Sanitary Engineering Branch). 1968. 133p. Dep. CFSTI.

Five commercial facilities for land burial of solid radioactive wastes were authorized and put in operation by the end of 1969. They are located in the states of New York, Kentucky, Nevada, Washington, and Illinois. Factors affecting the suitability, and information necessary for approval for waste burial are summarized for each site, including background, environmental characteristics, operating equipment and methods, and health and safety procedures set forth. Two selected examples of hydrogeological evaluations from the viewpoint of radiological safety are appended. (J.C.W.)

7618 SHIELDED CASK FOR RADIOACTIVE MATERIAL. Antonsen, Knud; Rosenberg, Richard; Wiard, Hadley K. (to Gulf General Atomic Inc.). U. S. Patent 3,483,380. 9 Dec 1969. Filed 9 Apr 1965.

A shielded cask is described that is particularly adapted to receive radioactive elements, such as nuclear fuel cells, including a housing having an access passageway at one end, a rack rotatably mounted in the housing and defining a plurality of compartments each adapted to receive an element. In certain specific embodiments, means are provided for varying the position of the access passageway relative to the housing, to maintain the elements in compartments, and to shift the rack within the housing to enable it to be supported by an interior wall of the housing for shipment. (Offic. Gaz.)

7619 SHIPPING CONTAINER FOR RADIOACTIVE MATERIALS HAVING CORNER SHIELDING MEANS. Bonilla, Charles F.; Brown, Steven H.; Reiter, Sydney H. (to National Lead Co.). U. S. Patent 3,483,381. 9 Dec 1969. Filed 9 Sept 1966.

A shipping container for radioactive materials is described in which the container cavity is of generally rectangular cross sectional configuration, there being an outer shell of the container of generally cylindrical configuration, which is spaced apart from the cavity, the intervening space being filled with radiation shielding material. At the corners of the cavity there are cast uranium inserts which are more dense than the lead which is employed as the primary shielding material. (Offic. Gaz.)

7620 UF_6 SAMPLING BUGGY (29 Jul 1969) (Engineering Materials). (Goodyear Atomic Corp., Piketon, Ohio). (CAPE-1934).

10 drawings.

A UF_6 sampling buggy is described that allows easy sampling

from 2½, 10, and 14 ton cylinders that cannot be easily moved from a liquefaction area to a stationary sampling station. The buggy is nearly independent in operation and only requires 120 Vac to operate the vacuum pump, line heating elements, and liquid N or comparable refrigerant to maintain adequate cold trapping. The UF_6 is withdrawn from the shipping cylinder to be sampled through a pigtail to a calibrated sample reservoir which holds ~60g. The cylinder opening is then closed and the sample drained into the sample container. A duplicate sample is obtained by repeating the procedure. Prior to and after sampling, the vacuum pump evacuates the sample lines through a cold trap and two chemical traps. The cold trap, which is usually refrigerated with liquid N, will function until 1500 g of condensed UF_6 accumulates. The chemical traps, containing equal parts of activated alumina and soda lime will effectively trap UF_6 for 2 to 6 months depending on operator technique and frequency of sampling. (For details TID-4100 Suppl. 56) (F.S.)

7621 MANAGING NUCLEAR FUEL. Schwieger, Robert G. Power; 113: No. 12, S1-S16(Dec 1969).

The aspects of procuring, warranting, and financing light water reactor fuels are considered for low-cost nuclear power. Various fuel cycle stages are presented and a survey of the companies providing these services is outlined. The computer programs needed to provide management guidance are outlined. (J.C.W.)

7622 RADIOACTIVE WASTE DISPOSAL AT A LARGE UNIVERSITY. Wollan, Ralph O.; Boge, Raymond J.; Staiger, Jerome W. (Univ. of Minnesota, Minneapolis). J. Amer. Coll. Health Ass.; 17: 315-24(Apr 1969).

The radiation protection program operated by the University Health Service at the University of Minnesota is described. Radioisotopes have been used at the University since 1948 and 225 approved users in approximately 325 laboratories used almost 82 curies during 1967. The procedures and techniques used for the transport and disposal of waste from the use of radioisotopes in the diagnosis and treatment of disease and in research are discussed. The categories of radioactive waste include solid noncombustible, solid combustible, liquids, water soluble liquids, flammable, organic, immiscible solvents, and contaminated animal carcasses. The greatest problems occur in the handling and disposal of animal carcasses and flammable and toxic solvents, and in the subsequent control over the release of radioactive effluents to the atmosphere. (L.C.L.)

7623 IMPROVEMENTS IN OR RELATING TO FLUID-TIGHT PASSAGE MEANS WHICH PERMIT THE TRANSFER OF NOXIOUS PRODUCTS THROUGH A WALL, e.g. FOR FILLING CONTAINERS. Godart, Michael; Pajot, Jacques Rene (to Commissariat a l'Energie Atomique). British Patent 1,175,873. 1 Jan 1970. Priority date 27 Jul 1966, France.

The design of a fluid-tight passage is given for transferring noxious products through a wall, having a tube sealed into the wall affording a passage from one side to the other of the wall and with threaded ends for cooperating with complementary threaded blocking caps. Removable protection caps are arranged to close the passage at respective sides of the wall. The passage receives a resilient tubular connection and enables movement from one side to the other side of the wall in the unit. The funnel tube extends within and a protective envelope surrounds the connection which is adapted, when between and compressed by the blocking caps, to effect fluid-tight connection with the funnel tube. The passageway and a part of the container extend within the connection and abutt an end of the funnel tube, and the protective envelope is arranged to surround a part of the container adjacent to the connection. The device may be permanently attached to the wall of a glovebox. (J.C.W.)

7624 DEVELOPMENT OF AN ANTHROPOMORPHOUS, REMOTE-CONTROLLED MACHINE FOR HANDLING RADIATION ACCIDENTS. Kleinwaechter, H. (Lab. for Development and Research, Loerrach, Ger.). pp 579-85 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

In handling radiation accidents personnel should be kept outside dangerous radiation fields wherever possible. It is obvious that human beings should generally be replaced by machines, which should possess the universal attributes of man, but be insensitive to high radiation activities. The master-slave system appears especially suitable. In this system the master is a human being who stays away from the radiation field in a safe room equipped with the necessary information and telecommand devices, and controls and watches the work of the slave from there. The master represents the brain of the machine. The slave is the actual machine and to a certain extent the executive motor part of the human being. It is equipped with limb-like devices, some sense organs such as stereo-television eyes, stereo-microphones, and, by means of power force meters, possesses a certain sense of touch. Further development towards a biped walking machine is outlined. The machine must be given human dimensions as existing atomic plants are made for human operation. (auth)

Vacuum Engineering

Refer also to abstract 8071.

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 7861, 7904, 8536, 8790, and 9094.

7625 (AECL–3455) VERSATILE RADIATION MONITOR USING A SILICON NUCLEAR PARTICLE DETECTOR. Jones, A. R. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Aug 1969. 26p. Dep. CFSTI (U. S. Sales Only). AECL $1,00.

A portable radiation monitor using a lithium-drifted silicon detector has been developed for health physics. It can be used to predict doses from gamma or x radiation, predict skin doses from beta rays, discriminate and estimate alpha, beta and gamma activity, and detect fast neutrons while discriminating against gamma rays. The electronic and mechanical design of the instrument is described. The response of the monitor to ionizing radiations is also discussed and so are the effects of temperature and battery voltage on this response. (auth)

7626 (AERE-M–2201) CALIBRATION JIG FOR SURFACE CONTAMINATION MONITORS. Stephenson, J.; Bruce, G. S. (Atomic Energy Research Establishment, Harwell (England)). Oct 1969. 8p. Dep. CFSTI (U. S. Sales Only). UK 2s. 6d.

The construction of a simple jig for the testing and calibration of alpha and beta/gamma surface contamination monitors is described. (auth) (UK)

7627 (IEA–157) CONSTRUCTION AND OPERATION OF A PROPORTIONAL GAS FLOW COUNTER. Nastasi, Maria Jose C.; Abrao, Alcidio (Instituto de Energia Atomica, Sao Paulo (Brazil)). Feb 1968. 16p. (CONF-660732–1). Dep. CFSTI (U. S. Sales Only).

From 18th Annual Meeting of the Brazilian Society for the Progress of Science, Blumenau, Brazil.

The construction and operation of a proportional gas flow counter for alpha and beta counting are described. Studies were made with the purpose of using domestic kitchen gas (LPG) as the counting gas. In order to extend the detector's life, special emphasis has been given to the chemical treatment of the gas. This counter is in routine work using the LPG as counting gas and exhibits very good plateaus for alpha and beta counting. The duration of the detector has been largely increased due to the convenient chemical treatment of the gas. (auth)

7628 (INR-P–1103) SURFACE BARRIER LITHIUM DRIFTED SILICON DETECTOR WITH EVAPORATED GUARD RING. Belcarz, E.; Chwaszczewska, J.; Slapa, M.; Szymczak, M.; Tys, J. (Institute of Nuclear Research, Warsaw (Poland)). 1969. 21p. Dep. CFSTI (U. S. Sales Only).

Lithium-drifted silicon planar detectors with surface barrier provided with an evaporated gold guard ring have been prepared. It has been found that the resistivity of the gap between central electrode and guard ring is comparable with the resistivity obtained in detectors with engraved guard rings. Application of such guard rings make the work at the detector bias voltage of the order of 300 V/mm feasible, reduces considerably the reverse currents and allows a precise definition of the geometrical active region of the detector. The energy resolution obtained for this type detector with active area of 0.7 cm^2 and thickness of 2.4 mm is 1.26 keV for 14.4 keV gamma radiation and 3.1 keV for 976 keV internal conversion electrons. (auth)

7629 (N–69–38123) ON THE POSSIBILITY OF INVESTIGATION OF PRIMARY COSMIC RADIATION BY TRACKS OF NUCLEAR PARTICLES IN METEORITES AND TEKTITES. Kasharov, L. L.; (and others). Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 30: 1790-1801(1967). 5p. (NASA-CR–105978). CFSTI.

It is shown that the investigation of primary cosmic radiation by the tracks of nuclear particles in meteorites and tektites is possible on the basis of the study of the depth of tracks and the results of measurements of the age of tektite hardening. (auth)(USGRDR)

7630 (ORNL–4459, pp 15-22) DETECTORS OF IONIZING PARTICLES AND RADIATION. (Oak Ridge National Lab., Tenn.).

The development of germanium semiconductor detectors, proportional counters, scintillation detectors, and uranium fission chambers is outlined. (W.H.K.)

7631 (ORNL–4459, pp 23-31) RADIATION MONITORING. (Oak Ridge National Lab., Tenn.).

Radiation monitoring equipment and methods development at ORNL for facility, personnel, and area monitoring are outlined. (W.H.K.)

7632 METHOD OF DETERMINING THE INTENSITY OF A NUCLEAR-RADIATION BURST. Grundy, Gary L.; Herickhoff, Robert J. (to Sperry Rand Corp.). U. S. Patent 3,479,509. 18 Nov 1969. Filed 19 Sep 1966.

A method is given of determining the intensity, or dose rate in roentgens per second, of a radiation burst pulse. A measurement is made of the time delay between the radiation burst pulse and an output pulse that is generated by a pulse generating circuit by ionization currents which are induced in a semiconductor device by the radiation burst pulse. (Offic. Gaz.)

7633 ENERGY TRANSFER IN TERNARY SYSTEMS. Conte, J. C. (Comissao de Estudos de Energia Nuclear, Lisbon). Trans. Faraday Soc.; 65: 2382-8(Sep 1969).

In the ternary scintillation system, benzene + 2.5 diphenyloxazole (PPO) + 2.2′-p-phenylene-bis-(5-phenyloxazole) (POPOP), both benzene and PPO molecules transfer their energy to POPOP and the overall transfer efficiency of benzene to POPOP in the presence of PPO depends on the transfer efficiencies for the energy transfer processes in the binary systems benzene + PPO and benzene + POPOP. The effect of PPO–POPOP radiative transfer is discussed. (auth) (UK)

7634 DOSE MONITORING METHODS IN MEDICAL LINEAR ACCELERATORS. Sutherland, W. H. (Velindre Hospital, Cardiff, Wales). Brit. J. Radiol.; 42: 864(Nov 1969).

Patient dose is frequently monitored by means of parallel plate ionization chambers. A weakness in this procedure is briefly noted. Such a chamber is excessively sensitive to the intensity of peripheral rays passing through it, but these rays are those which are the least used and the least stable part of a beam from a linear accelerator. A set of flatness profiles was measured in air at 100 cm focus-chamber distance from a 4-MeV accelerator. The profiles were normalized to 100% at the left hand edge of the beam to display the shape variation. The defect was easily removed by a modified chamber plate assembly, collecting ion current only from the central part of the chamber. (UK)

7635 ION RECOMBINATION IN TIME-VARYING X-RAY FIELDS. George, David Lewis. Philadelphia, Univ. of Pennsylvania (1968). 167p.

Thesis.

A first order equation has been developed to calculate the volume recombination losses in an ionization chamber. There are no restrictions on the geometry of the chamber. Also, the expression is valid for any periodic exposure rate variation. Experimental data obtained from the saturation response of the chamber to a constant exposure rate serves as a basis of reference for any other exposure rate waveform. The single physical parameter of the chamber that the theory requires is the experimental determination of the average value of the ion transit time across the chamber to the collecting electrode. In addition, it is necessary for the analysis to represent the periodic exposure rate waveform as a Fourier series. The theory has been tested for one ionization chamber with 60 Hz half- and full-wave units, and with a pulsed beam from a 6 MeV linear accelerator. The experimental and calculated saturation curves show agreement for these cases. (Diss. Abstr.)

7636 THE CHARACTERISTICS OF NISHINA-TYPE IONIZATION CHAMBER. Kusunose, Masahiko (Kochi Univ., Japan); Wada, Masami. Rikagaku Kenkyusho Hokoku; 45: 93-104(Sep 1969). (In Japanese).

Characteristics of a Nishina-type ionization chamber are described. The chamber was designed and manufactured by the I.P.C.R. during the period from 1934 to 1941. It consists of a steel cylinder with a hemisphere at one end. It has an effective volume of about 21 liters and is used at 30 to 50 atms of pure argon. The ionization current is measured by a vibrating-reed electrometer and the output is recorded on a continuously moving paper of 25 cm width driven by an automatic servo-system. This electrometer system is suitable for a long period observation with its electric and mechanical mechanism. The chamber has an auxiliary uranium chamber for β-rays as well as for cosmic rays. The inverse current from the uranium chamber compensates most of the ionization current from the cosmic-ray chamber

so that the variation of cosmic-ray intensity only is recorded with highest sensitivity of the recording system. The residual ionization currents of three chambers were measured at an underground where the intensity of cosmic rays is one-160th of that at sea level. The relation between the residual current and the current due to β-rays from uranium indicates that the former is affected by the β-rays leaking out from the uranium chamber. When the gas pressure is lower than 5 atms, the current due to α-rays from the wall of the chamber predominates. When it is more than 30 atms, the residual current seems to tend to saturate. The problems concerning the long term observation by means of the chamber are discussed. One of the serious problems is the leakage of argon gas. Though the gas pressure is measured by a pressure gage attached to the chamber, in order to assure the change in sensitivity of the chamber, the ionization current of the uranium chamber should be checked periodically. The correction method applicable to the variation of the observing condition is proposed. It is noted that, even though the correction is performed, care should be taken to investigate precisely the time variation of cosmic-ray intensity. (auth) (NSA of Japan)

7637 DYNAMIC CHARACTERISTICS OF CYLINDRICAL IONIZATION CHAMBER. Koyanagi, Takami; Aida, Kazuo (Niigata Univ., Nagaoka, Japan). Trans. Soc. Instrum. Contr. Eng.; 5: 305-12(Oct 1969). (In Japanese).

A design consideration for a fast response radiation thickness gage which uses a cylindrical ionization chamber as the detector is described. It is pointed out that, in realizing a fast response, the time lag in the response of the ionization chamber must be taken into account as well as that in the amplifier stage. According to the expressions derived for the transient responses of the overall system, fundamental requirements are considered for attaining a fast response or a short rise time ($0.1 \sim 0.9$) in the indicial response. Besides the importance of using an amplifier with small time lag, it is shown that the ionization chamber has an optimum ratio of the diameter of the outer electrode to that of the inner electrode, depending upon the time lag in the amplifier. When the amplifier has a fairly large time lag, a small value of the ratio is preferable in the design of the ionization chamber. This will reduce the time required for positive ions to reach the outer electrode. On the contrary, in case that the time lag is relatively small, a large value of the ratio is recommendable so as to increase the output voltage due to electrons. It is also shown that the response time can be improved more or less by either raising the voltage between the electrodes (V_0) or lowering the filling gas pressure (p) or employing a filling gas with high mobility (μ_0), but then these procedures are effective only within a limited range of the value of $V_0\mu_0/p$. (auth) (NSA of Japan)

7638 OPTICAL TRANSFER FUNCTION IN ^{192}Ir RADIOGRAPHY. (FILM-LEAD SCREEN COMBINATION). Maeda, Syo; Kobayashi, Masatoshi (Japan Atomic Energy Research Inst., Tokai). Hihaki Kensa; 18: 338-42(Aug1969). (In Japanese).

The optical transfer function of the typical X-ray film-lead screen combination in ^{192}Ir radiography was obtained by means of Fourier transformation of the measured line spread function. The effect of a slit system on the measurement of the line spread function of a film-lead screen combination is critical in γ-ray radiography. The transformation from the photographic density to the exposure dose is generally nonlinear in the mathematic treatment, but the conversion was quite easy because the film density was proportional to the radiation exposure in the typical film-lead screen combination. It is very difficult to obtain the optical transfer function of X-ray film itself in ^{192}Ir radiography, because the film without a lead screen is exposed to secondary electrons emitted from the slit walls. But it is sufficient in practical use to treat the film-lead screen combination as one receptor system in ^{192}Ir radiography. The contribution of the direct γ-ray to the photographic density of the film is about 30%, therefore the blur due to film emulsion can not be neglected. (auth) (NSA of Japan)

7639 POSITION-SENSITIVE RADIATION DETECTOR. Borkowski, C. J.; Kopp, M. K. (to United States Atomic Energy Commission). U. S. Patent 3,483,377. 9 Dec 1969.

A position-sensitive radiation detector is provided by inserting a very high resistance collector in an otherwise conventional detector. The rise time of any pulse therefrom is thereby position-sensitive, but energy independent. The rise time, and therefore the position, is accurately determined by pulse shaping and timing means. (AEC)

7640 A SIMPLE AND VERSATILE GAMMA-RAY SOURCE FOR THE CALIBRATION OF HIGH-ENERGY Ge(Li) SPECTRA. Van Der Leun, C.; De Wit, P. (Univ., Utrecht). Phys. Lett., 30B: 406-8(Nov. 10, 1969).

A simple and inexpensive neutron-capture source of monoenergetic high-energy γ-rays of many different energies suited for the energy-calibration of Ge(Li) spectra, is described. An americium-241 – beryllium neutron source is used. (auth)

7641 ACTIVATION SPECTROMETRY OF FAST NEUTRONS BY IAEA THRESHOLD DETECTORS AT NEUTRON GENERATORS. Nikodemova, Denisa; Hrabovec, A.; Minarik, F. (Research Inst. of Industrial Hygiene and Occupational Diseases, Bratislava). pp 259-67 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The suitability of the IAEA set of threshold detectors for neutron accident purposes was investigated. A generator producing 14.3-MeV neutrons by the T(d,n)^{4}He reaction was employed for this purpose. ^{237}Np, ^{232}Th, ^{58}Ni and ^{27}Al threshold detectors were used. The induced activity was determined by gamma spectrometry using a multichannel analyzer. Fast neutron spectra have been estimated from the experimental results. Measurements at the surface and at the depth of a phantom were provided. Some difficulties from low induced and fission activities (caused by the small neutron flux density and the light weight of the detectors) are pointed out. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 8832, 8864, and 9145.

7642 (BMwF-FBK-69-36) ANNUAL REPORT, 1967/68. (Bonn Univ. (West Germany). Institut fuer Strahlen und Kernphysik). Oct 1969. 184p. (In German). Dep. CFSTI (U. S. Sales Only).

This annual report of the Institute for Nuclear and Radiation Physics at the University of Bonn gives information about the scientific work carried out during the period 1967–1968 in the field of nuclear spectroscopy and nuclear reaction physics. Details are also given about the equipment under construction (isochronous cyclotron, beam analyzing system, isotope separator, split pole spectrograph, and data handling equipment). Publications issued during the period are listed. (auth)

7643 (BNL-14110) STUDIES OF THE (n,γ) REACTION WITH A NEUTRON MONOCHROMATOR. Kane, W. R.; Gardner, D.; Brown, T.; Kevey, A.; der Mateosian, E.; Emergy, G. T.; Gelletly, W.; Mariscotti, M. A. J. (Brookhaven National Lab., Upton, N. Y.); Schroeder, I. (National Bureau of Standards, Washington, D. C.). 30 Oct 1969. 12p. (CONF-690802-3). Dep. CFSTI.

From International Symposium on Neutron-Capture Gamma-Ray Spectroscopy, Studsvik, Sweden.

A crystal diffraction neutron monochromator was constructed specifically for studies of the (n,γ) reaction. This equipment plays a complementary role to that of time-of-flight devices in providing a neutron beam with a full duty cycle at a given energy. This feature and the small target size, large geometrical efficiency for γ-ray detection, and negligible fast neutron background afford advantages for certain classes of experiments. The useful energy range extends from 0.01 to 20 eV. Novel features of the equipment include a complete reliance upon precision angle encoders for setting arm and crystal angles, the employment of a liquid shield to facilitate the extraction of the diffracted neutron beam, and the use of air bearings to provide for the motion of the target, detection devices, and associated shielding. Results obtained on low energy resonances of ^{139}La, ^{189}Os, and ^{235}U are presented. (auth)

7644 (CONF-690301–, pp 340-53) ARMSPAN: ARGONNE MULTICHANNEL STORED PROGRAM ANALYZER. Lenkszus, F. R.; Strauss, M. G. (Argonne National Lab., Ill.).

A pulse height analysis system based on a computer (DDP-116) with a memory of 4096 16-bit words has been developed. While the cost of the system is comparable to that of a conventional multichannel analyzer, its capabilities are far greater. The system features include single or 2-parameter pulse height analysis, software controlled servo-stabilization of gain and zero-intercept, digital bias, flicker-free interlaced display, etc. The deadtime of the system is comparable to that of a conventional multichannel analyzer. Data are stored in 3000 memory locations and programs in the remainder. Basic functions such as ACCUMULATE, DISPLAY and READOUT are controlled by special front panel sense switches. Communication between operator and computer is in decimal. Prompt calculations on the accumulated data provide the researcher with key parameters which enable him to determine whether the data are meaningful and he should proceed, or the run should be repeated. Similar calculations at a later time may result in inefficient use of time and experimental facilities. (auth)

7645 (IEA-150) ON SOME EFFECTS THAT INFLUENCE THE NEUTRON RESONANCE MEASUREMENTS. Fulfaro, R.;

Stasiulevicius, R. (Instituto de Energia Atomica, Sao Paulo (Brazil)). 1967. 31p. Dep. CFSTI (U. S. Sales Only).

The calculation of the resolution function of a neutron crystal spectrometer is presented, as well as the calculation of the second order neutron contamination for the (111) planes of an aluminum crystal. In order to estimate the influence of these effects in the neutron total cross section measurements, the iridium resonance at energy $E_0 = 0.654$ eV, was considered. The theoretical curve of the resonance was calculated using the Breit–Wigner formula, taking into account the Doppler broadening at room temperature. This curve was affected by the resolution function; the second order neutron contamination was calculated, and a final curve was obtained whose shape coincided with the experimental one. The resonance curve was measured by the transmission method and the experimental points do agree with the expected theoretical curve, thus indicating a good theoretical interpretation of the considered effects and an accurate calibration of the instruments. (auth)

7646 (IITRI–578-P-33-12) DEVELOPMENT OF NEUTRON SPECTROMETRY FOR CRITICAL FACILITIES. Quarterly Report No. 4, July 1–September 30, 1969. Semmler, R. A. (IIT Research Inst., Chicago, Ill.). Dec 1969. Contract AT(11-1)-578. 25p. Dep. CFSTI.

Calibration and testing of a wall-less proportional counter for neutron spectrometry in the 1 to 100 keV energy region using the proton recoil technique were completed during this quarter. The counter and all associated electronics were transported to Argonne National Laboratory for testing in a fast flux environment. The tests in both thermal and fast neutron fluxes were generally successful. A survey of the results is given. Recommendations for changes in the test procedures to improve the low energy response are outlined. Also recommended are modifications to be incorporated into a new detector assembly to reduce the likelihood of electrical breakdown problems. (auth)

7647 (UJV–2213-Ch) THE CORRECTION OF THE SCINTILLATION GAMMA SPECTRA FOR THE INSTABILITY OF THE SPECTROMETER. Slunecko, J.; Kovanic, P. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Jul 1969. 51p. Dep. CFSTI (U. S. Sales Only).

The computer program COGARASS, written in Gier–Algol III for the Gier computer is presented. This program corrects gamma scintillation spectra for quantitative analysis of mixtures of radioisotopes. No standard sample is used. Instead, the correction procedure utilizes photopeaks in the spectra as reference peaks. (W.H.K.)

High Energy Physics Instrumentation

Refer also to abstracts 7677, 7679, and 8781.

7648 (BNL–14183) PARTICLE IDENTIFICATION AT RELATIVISTIC ENERGIES BY THE USE OF SECONDARY EMITTERS WITH NEGATIVE ELECTRON AFFINITY. Llacer, J. (Brookhaven National Lab., Upton, N. Y.). [1969]. 16p. (CONF-700301–1). Dep. CFSTI.

From 12th Scintillation and Semiconductor Counter Symposium, Washington, D. C.

The usefulness of negative electron affinity secondary emitters as detectors of particles in the high relativistic region is studied theoretically in detail. It is found that GaP(Cs) has poor secondary escape statistics, resulting in the inability to distinguish between 200 BeV/c protons and pions in single particle experiments. GaAs (Cs + (O_2 + C_s)) has good escape statistics, but its active depth may be too large, and density effects are expected to set in. A $GaP_{(1-x)}$–$GaAs_{(x)}$ heterojunction which could solve both problems is discussed. In any case, it is found that nonlinear filtering of the near Landau distributed signals from secondary emitters is required in order to obtain useful particle discrimination. One feasible scheme is proposed which should allow separating 200 BeV/c protons and pions, for example, with 90% effieicncy or better at near 100% confidence. (auth)

7649 (JINR–P13-4702) ON THE EFFECT OF ULTRASOUND ON THE FORMATION OF IONIZING PARTICLE TRACKS IN LIQUID-HYDROGEN BUBBLE CHAMBER. Akulichev, V. A.; Gavrilov, L. R.; Grebinnik, V. G.; Zhukov, V. A.; Libman, G.; Manych, A. P.; Rudin, Yu. I.; Rozenberg, L. D.; Selivanov, G. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1969. 15p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The effect of ultrasound on the formation of ionizing particle tracks in liquid-hydrogen bubble chamber is investigated experimentally. Design features and characteristic regimes of acoustic systems leading to a considerable effect of ultrasound on the increase of bubbles, which form tracks, are described. (auth)

7650 (N–69-38182) VERSATILE LIQUID HELIUM SCINTILLATION COUNTER OF LARGE VOLUME DESIGN. Buckle, D. C.; Kane, J. R.; Orrick, B. D.; Siegel, R. T.; Wetmore, R. J. (College of William and Mary, Williamsburg, Va. Dept. of Physics). [1968]. 19p. (NASA-CR–106008; WM–18). CFSTI.

A 3 liter liquid helium counter has been assembled and used in two experimental configurations. The operation of the scintillation chamber is described in terms of these experiments, and the pulse height and resolution characteristics of the counter are given for the case where two 5 in. diam phototubes view the liquid helium with good geometry. (auth)(USGRDR)

7651 (SLAC–106) 40-INCH HYDROGEN BUBBLE CHAMBER CONVERSION TO 70 KILOGAUSS SUPERCONDUCTING MAGNET. Proposal III. Alcorn, John; Ballam, Joseph; Blumberg, Richard; Brechna, Habibo; Petersen, Henning; Rogers, Arthur; St. Lorant, Steven; Skarpaas, Knut; Sukiennicki, Bohdan (Stanford Linear Accelerator Center, Calif.). Sep 1969. Contract AT(04-3)-515. 120p. Dep. CFSTI.

Extensive design modifications for the SLAC 40-inch bubble chamber magnet to provide it with a 70 kG magnetic field and an improved optical system are proposed. Design of the superconducting magnet system is described, and modifications for the vacuum tank, coil dewar assembly and supports, refrigeration system, chamber body, optical system, and expansion system are described. A time schedule and cost estimate are presented. (W.H.K.)

7652 DETERMINATION OF PARTICLE TRAJECTORY PARAMETERS BY MEANS OF DIRECT COINCIDENCE OF THE TRAJECTORY PROJECTION WITH THE TRACK PICTURE WITHOUT MEASURING SEPARATE POINTS. Sokolov, S. N. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 10: 794–6(Oct 1969). (In Russian).

A method is presented of reconstruction of the particle momentum vector from the stereo-photograph of the track in a bubble chamber. The main advantage of the method (as compared with scanning of the television or spiral type) is that it is not necessary to record, filter, and calculate the coordinates of the separate bubbles. Besides, the method is stable to the noise from crossover and near-lying tracks and from the photograph defects. (auth)

Radiation Dosimeters

Refer also to abstracts 7415, 7634, and 7904.

7653 (AECL–3379) PHANTOM MEASUREMENTS TO DETERMINE THE MOST SUITABLE SITE FOR THE PERSONAL DOSIMETER. Ambiger, T. Y. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Jul 1969. 13p. Dep. CFSTI (U. S. Sales Only). AECL $0.50.

It is usual to wear personal dosimeters on the chest (clipped to the tie), on shirt or jacket pockets or attached to waist level belts. While a thermoluminescent-dosimeter system for personal dosimetry is being developed it is interesting to see which of these three positions is best for estimating the dose to the testes (the least shielded critical organ). TL dosimeters (in a film holder) on a realistic phantom were irradiated over a range of energies (0.03–1.25 MeV) and in different directions (from in front, behind and all around) and the readings compared with that of a dosimeter at the testes site. The source was 2 metres from the phantom. The estimates obtained from the three dosimeter positions were not very different except in the case of the dosimeter worn at the center of the chest. This dosimeter considerably underestimated the testes dose for irradiation from behind. The dosimeters worn in the other two positions gave a correct estimate within a factor over two regardless of energy or direction. Probably the best position is the waist since it is the nearest to the testes. When the source is on the floor, above the worker or very close to him, this waist position is most likely to give the best estimate of the testes dose. (auth)

7654 (K–1779) IMPROVED FABRICATION TECHNIQUES FOR ^{6}Li FLUORIDE–TEFLON AND LEAD SHIELDS FOR GAMMA DOSIMETRY. Rivers, R. D.; Williams, J. W.; Lee, Ted; Kienberger, C. A.; Weber, C. W. (Oak Ridge Gaseous Diffusion Plant, Tenn.). 22 Dec 1969. Contract W-7405-eng-26. 38p. Dep. CFSTI.

The development of lithium-6 fluoride-Teflon (^{6}LiF-Teflon) and lead shield assemblies to provide inexpensive dosimeters for gamma radiation is reviewed. The newly developed techniques include molding, in one pressing, the complete ^{6}LiF-Teflon shield with a center hole for silver-activated phosphor glass rod detectors; lead foil serves as the lead source for the shield assembly. A description of the equipment, as well as the automation portion of the pressing procedures, is also presented. (auth)

7655 (UCRL-71731) ACCELERATOR PULSED FIELD DOSIMETRY. Zurakowski, Paul R. (California Univ., Berkeley. Lawrence Radiation Lab.). 7 Nov 1969. Contract W-7405-eng-48. 24p. (CONF-691101-9). Dep. CFSTI.

From 2nd International Conference on Accelerator Dosimetry and Experience, Stanford, Calif.

Bremsstrahlung and neutron measurements made with an LRL-developed calorimeter and pulsed neutron detector in pulsed fields varying in energy from 2 to 15 MeV are discussed. Accelerators that were used in the study were 4, 12, 13, and 5 to 15 MeV Linacs, and the LRL 14 MeV 10^{12} n/sec neutron generator. The x-ray measurements, made under electronic equilibrium conditions, were compared with those made with TLD 700 powder and extruded ribbon, a SLAC type RAMS, Victoreen thimble chambers and portable survey equipment with particular emphasis on energy and dose rate dependence. Calorimeter and TLD agreement was excellent. The ionization chambers showed varying degrees of dose rate and energy dependence. The effects of neutrons and beam electrons were also studied. Neutron flux, dose and average energy measurements were in excellent agreement with those found in the literature. An Andersson–Braun type portable neutron instrument was compared with the pulsed neutron detector and found to be somewhat dose rate dependent. Skyshine calculations and measurements are presented for a 13 MeV Linac. The calculations agreed with the measurements to within a factor of 2. (auth)

7656 (UCRL-Trans-10417) CALIBRATION OF RADIAL REACTOR CALORIMETERS. Kott, J. Translated by J. Berger (Lawrence Radiation Lab., Livermore, Calif.), from Jad. Energ.; 14: No. 2, 56-63(1968). 36p. Dep. CFSTI.

The theory of reactor calorimeter calibration is discussed. Modes of accumulation of thermal energy as a result of reactor irradiation of a substance, analysis of heat losses of a reactor calorimeter, relationships for calculating the total radiation energy absorbed in the calorimetric sample, and operation regimes of radial reactor calorimeters are considered. The differences in the temperature distribution in cylindrical calorimetric samples during calibration and during radiation heating are described. In the analysis special attention is given to adiabatic and isothermal operation of the calorimeter. Relations for calorimetric calibration based on analysis of the cooling curve after irradiation in the reactor are given as well. The time criteria determining the equivalence between calibration and radiation heating of a radial reactor calorimeter are summarized, and a list of materials for which the comparative calculations have been carried out is given. (auth)

7657 RADIUM DOSE FILM DOSIMETRY. Musialowicz, T. (Central Lab. for Radiological Protection, Warsaw). Post. Fiz. Med.; No. 1, 27-33(1968). (In Polish).

The photographic film dosimetry method is used for measurements of x and gamma radiation and beta particles in definite energy ranges. The method also makes it possible to estimate thermal neutron fluences. Special wide-range dosimetric films allow measurement of radiation in the dose range greater than 10^{-4} rads. The multi-filter film holder makes it possible to assess the type and energy of radiation. Under known irradiation conditions the accuracy of the dose estimation is ±20%. (auth) (NSA of Poland)

7658 TESTING OF GLASS DOSIMETERS FOR OFFICIAL PERSONNEL MONITORING. Midecke, P. (Staatl. Materialpruegsamt, Dortmund, Ger.). Atomwirt., Atomtech., 14: 354-7(July 1969). (In German).

In the search for a method for the official personnel dose monitoring which is better than the film dosimeters now used, the suitability of phosphate glass dosimeters was evaluated. Although phosphate glass can display some advantages with respect to the film, the results of the testing proved that the introduction of glass dosimeters in place of the film dosimeters would bring no basic improvements. Thermoluminescent dosimeters appear suitable for conversion. (tr-auth)

7659 STIMULATED EXOELECTRON EMISSION DOSIMETERS. Becker, K. H. (to United States Atomic Energy Commission). U. S. Patent 3,484,610. 16 Dec 1969.

The use of low-energy electrons emitted from thin layers of irradiated ionic crystals when stimulated by optical or thermal means for dosimetry is discussed. The detector crystals are selected from the group consisting essentially of LiF, BeO, $CaSO_4$, $BaSO_4$, $SrSO_4$, $Li_2B_4O_7$, and CaF_2. Specially constructed detectors and/or combinations of operating conditions provide for dosimetry of photons, thermal neutrons, fast neutrons, beta radiation, heavy ions, and/or combinations thereof in a wide dose and energy range. In addition, information may be obtained as to several important characteristics of the radiation such as the energy distribution thereof. (AEC)

7660 LOW-TEMPERATURE ANNEALING BEHAVIOUR OF TLD LITHIUM FLUORIDE. Harris, A. M.; Jackson, J. H. (Central Electricity Generating Board, Berkeley, Eng.). J. Phys., D (London); 2: 1667-74(Dec 1969).

Studies of the pre-irradiation isothermal fading of glow peaks in thermoluminescent-dosimetry-grade lithium fluoride showed that two peaks are associated with divalent impurity–positive ion vacancy dipoles, not one as previously thought. The decay of these peaks is shown to obey second-order kinetics with an activation energy of 0.83 ± 0.05 eV. The implications of these results for practical dosimetry are discussed. (auth) (UK)

7661 STABLE CHEMICAL DOSIMETERS FOR PARTIAL RECONSTRUCTION OF NUCLEAR ACCIDENT CONDITIONS. Dvornik, I.; Zec, U.; Baric, M.; Razem, D. (Ruder Boskovic Nuclear Inst., Zagreb). pp 225-33 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The application of chemical dosimeters, tissue equivalent with respect to gamma rays and neutrons, is proposed for dosimetric topography of the space around nuclear devices in case of accidents. The dosimeters in the form of sealed glass ampoules have sufficient sensitivity and long-term stability and are evaluated or checked directly by conventional spectrophotometry. The sensitivity, expressed and yield per rad, is approximately equal for gamma rays and neutrons. The resolution in both cases is about one rad, and the range is up to several thousand rads. The precision of dosimetry is ±1 rad or ±2%, whichever is higher. In free space and unshielded the dosimeter measures the total rad-absorbed dose delivered by gamma rays and neutrons, i.e., the first collision gamma plus neutron dose. If used on- or in-phantom, especially if several dosimeters are disposed within and around the same phantom, it can give important data about the amount of the neutron component of the dose and about the effective mean energy of incident neutrons. The neutron component of the dose can be directly measured if the gamma dosimeter is used together with the chemical dosimeter. The experiments giving the change of optical density per rad and the radiation chemical yield with respect to the absorbed dose delivered by 14-MeV neutrons are described in detail. The possibility is also mentioned of applying the dosimeter as a very sensitive monitor for thermal neutrons, which is due to the chlorine content of 4.73% and activation to ^{38}Cl. The opinion is expressed that this dosimeter deserves some attention as a part of future planning and development work on area and personnel accidental dosimetry systems. (auth)

7662 EMERGENCY PERSONAL DOSIMETERS FOR GAMMA-NEUTRON RADIATION. Bochvar, I. A.; Vasil'eva, A. A.; Gimadova, T. I.; Keirim-Markus, I. B.; Kraitor, S. N.; Kushnerev, A. Ya.; Sergeeva, N. A.; Uspenskii, L. N.; Chernova, O. N.; Yakubik, V. V. (Inst. of Biophysics, Moscow). pp 235-45 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In Russian).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

Two dosimetric systems are considered—thermoluminescent dosimeters made of aluminophosphate glass for measuring gamma-radiation doses, and fissionable materials in combination with a track detector for measuring neutrons. The gamma dosimeters are made in the form of aluminum buttons 16 mm in diameter and 5 mm in thickness, inside of which is a glass plate (8 mm in diameter and 1 mm in thickness) with a packing of heat-resistant rubber. The dosimeter weighs 2 g. The dosimeters are placed on the wearer's special clothing at 8 points and can withstand repeated cleaning operations. The basic dosimetric characteristics of the device are discussed. ^{235}U and ^{237}Np behind a filter consisting of a layer of ^{10}B are used for recording neutron kerma. GOST-683-52 glass with an area of 1 cm^2 is used for detection. The sub-threshold fission of ^{237}Np and the effect of the possible presence of ^{235}U and ^{239}Pu impurities therein are taken into consideration. It is shown that the error in the determination of the kerma of neutrons for neutron spectra actually present behind the shield is about 12%. The maximum sensitivity of the dosimeter is about 2 mrad/track and the measurable range of kerma is 0.02–10^5 rad. (auth)

Radiometric Instruments

Refer also to abstracts 7512, 7603, 7637, and 8829.

7663 (N-69-38649) FEASIBILITY STUDY OF ALPHA PARTICLE DENSITOMETERS FOR MEASURING PLANETARY

ATMOSPHERIC DENSITY. Final Report, July 1968–May 1969. Hanser, Frederick A.; Sellers, Bach (Panametrics, Inc., Waltham, Mass.). Jun 1969. Contract NAS1-8487. 154p. (NASA-CR-66825). CFSTI.

The use of radioactive alpha particle sources to measure gas density has been investigated. Such systems consist of a source separated from a detector by a fixed distance, with a gas then reducing the alpha energy. The thin source system uses a monoenergetic alpha source and measures the average energy loss, while the thick source system uses a source having a broad spectrum and measures the count rate above a fixed threshold. For either system used in combination with CO_2, N_2, and Ar atmospheres the measured density is given by $\rho_m = \rho_{CO_2} + \rho_{N_2} + 0.67\ \rho_{Ar}$ to ±2%. The thin source system gives greater accuracy at high densities, while the thick source system can have the accuracy adjusted to be better at low sensities. Use with an x-ray attenuation system allows the quantities $\rho_{CO_2} + \rho_{N_2}$ and ρ_{Ar} to be determined separately. When no composition information is available the α particle system alone will measure the density of the Martian atmosphere to ±8%, based on the extreme VM models. (auth)(USGRDR)

7664 IONIZATION DETECTOR ELECTRODE ASSEMBLY AND METHOD OF ANALYZING GAS AND VAPOR SUBSTANCES. Sporek, Karel F. (to Owens-Illinois, Inc.). U. S. Patent 3,478,205. 11 Nov 1969. Filed 29 Jul 1965.

An ionization detector and method of analyzing gas and vapor substances is described which utilizes a low power source of ionizing radiations, eliminating heavy shielding: The system has an improved detector electrode assembly in a glass or other nonconductive body, the detector having an inlet at one end and an outlet at the other end with a central ion collecting electrode with a low level radioactive source (promethium 147) adjacent the inlet and away from the electrode assembly to subject the gas to be examined to radiation. Argon and helium gases are examples of noble carrier gases disclosed, and in the case of helium gas the detector operates as an electron capture detector. (Offic. Gaz.)

7665 APPLICATION OF NEUTRON MOISTURE-GAUGE IN STEEL INDUSTRY. Miyagawa, Kazuo; Mishima, Isamu (Fuji Iron and Steel Co., Himeji, Japan). Trans. Iron Steel Inst. Jap.: 9: 285-96(Jul 1969).

A series of fundamental experiments and on-line tests were conducted for the utilization of a neutron moisture gauge in the steel industry. A method of automatic moisture control for the sinter raw mixture as well as an automatic moisture control method for the blast furnace coke were developed. The principle of operation of this neutron moisture gage, the results of experiments, and the condition of control are reported together with some problems encountered during the on-line tests. (auth) (NSA of Japan)

7666 NUCLEAR RADIATION GAUGE SYSTEM. Clerc, Milton C. (to Industrial Nucleonics Corp.). U. S. Patent 3,479,511. 18 Nov 1969. Filed 1 Jun 1965.

A radiometric measuring system with a scanning gage to be mounted for movement across a traveling sheet of material formed or treated in some way by an industrial process is described. The scanning gage comprises a sensor whose output varies with a property of the sheet material. The gage includes means for generating a radio-frequency signal and electromagnetically radiating the signal to a location remote from the gage position. The sensing means condition causes the frequency of the signal to vary, converting the property variation into a proportional change in the radiated signal. At a remote location, means is provided for receiving the electromagnetically radiated signal, measuring the frequency change, and converting the frequency change into a corresponding indication of the property. (Offic. Gaz.)

Miscellaneous Instruments and Components

Refer also to abstracts 7591, 7642, 8038, 8399, 8756–8767, 8769–8776, 8892, 9080, 9136, 9147, 9148, and 9157.

7667 (ACRH-1000-162) AN AUTOMATIC PATIENT-CONTOUR MEASURING APPARATUS. Lanzl, Lawrence H.; Ahrens, Thomas J.; Rozenfeld, Martin; Bess, Leon (Argonne Cancer Research Hospital, Chicago, Ill. Chicago Univ., Ill. Dept. of Radiology). [nd]. 11p. (CONF-691021-1). Dep. CFSTI.

From 12th International Congress of Radiology, Tokyo, Japan.

The determination of isodose distributions for radiation treatment planning requires one or more cross sections of a given patient through the tumor volume. An automatic contouring system based on an optical-electronic rangefinder coupled to a polar plotter is described. The optical portion of the system is incorporated in the rotating structure of a moving field cobalt-60 teletherapy unit. The patient's contour is recorded on a polar plotter as the rangefinder revolves about the patient. (W.H.K.)

7668 (AERE-M-2249) AN INVESTIGATION OF METHODS OF TIME SCANNING A SINGLE-CHANNEL PULSE AMPLITUDE SELECTOR. Cole, H. A. (Atomic Energy Research Establishment, Harwell (England)). Oct 1969. 12p. Dep. CFSTI (U. S. Sales Only). UK 2s. 6d.

Experimental results are given for the use of a recently designed pulse amplitude selector (Harwell 2000-Series Type 2252) operated in various modes of spectrum scanning, and whose channel width and channel position are controlled by an external analog voltage. (auth) (UK)

7669 (CONF-690301) PROCEEDINGS FOR THE SKYTOP CONFERENCE ON COMPUTER SYSTEMS IN EXPERIMENTAL NUCLEAR PHYSICS. (Columbia Univ., New York). Oct 1969. 652p. (EANDC(US)-121-U). Dep. CFSTI.

Separate abstracts were prepared for 40 of the 54 papers presented. For abstracts of papers that previously appeared in NSA see CONF-690301 in a cumulative report number index. (W.H.K.)

For abstracts of individual papers see: 7644, 7670–7686, 8756–8776, and 8884.

7670 (CONF-690301–, pp 32-6) ON-LINE SYSTEM INTERACTING WITH OFF-LINE UNIVERSITY COMPUTER CENTER. Norbeck, E. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy).

A complicated multiparameter nuclear physics experiment can place enormous demands on the device that collects and processes the data. To meet these demands the experimental task is split into two separate parts, a data acquisition part and a data reduction part. A small on-line computer, 160-A, handles all operations related to data acquisition. It reads the ADC's, records the events on magnetic tape, and generates oscilloscope displays for monitoring the progress of the experiment. Any data reduction that cannot be done easily with the on-line computer is done with a large computing facility, a 768 byte 360/65. The link between the two systems is the magnetic tape which is written in a specialized format that is the same for all experiments. The data reduction step produces contour maps, graphs, and tables. The tables that are to be used in later calculations are stored on magnetic tape or disk. The visible output is usually generated on the line printer where the turnaround time is faster than with special plotting devices. Simple and straightforward Fortran programming techniques have resulted in programs that are easy to use and easy to understand and modify. (auth)

7671 (CONF-690301–, pp 77-90) FAST NEUTRON-AUTOMATED DATA ACQUISITION SYSTEM. Whalen, J. F. (Argonne National Lab., Ill.).

A discussion of the development and operation of the computer-based data acquisition systems at the Argonne fast-neutron laboratory is presented. (W.H.K.)

7672 (CONF-690301–, pp 91-105) DESIGN, USAGE, AND REDESIGN OF A NUCLEAR PHYSICS DATA ACQUISITION SYSTEM. Birnbaum, J. (IBM Watson Research Center, Yorktown Heights, N. Y.).

The criteria and objectives for the design of the Yale/IBM Nuclear Data Acquisition system are summarized, and a critique of its initial operation is presented. This experience has led to the redesign of a number of systems components, particularly the programming structures. These are discussed and examples of resultant improvements and extensions to other applications are presented. (auth)

7673 (CONF-690301–, pp 266-75) BONER: AN ON-LINE MULTI-LABORATORY DATA ACQUISITION SYSTEM. Jones, Hugh V. Jr.; Buchanan, James A. (Rice Univ., Houston, Tex. Bonner Nuclear Labs.).

BONER, a programmed on-line multi-laboratory data acquisition system, implemented on Bonner Nuclear Laboratories' I.B.M. 1800 Computer and supported by IBM's TSX (Time-Sharing Executive), incorporates the following features: (i) independent concurrent acquisition and analysis of data from a maximum of eight laboratories; (ii) dynamic real time storage allocation of data input/output buffers, processed or unprocessed data accumulation buffers, and program blocks; (iii) dynamic allocation of peripheral equipment needed by laboratories; (iv) selective program-controlled display of data accumulation area; (v) and nonprocess time-sharing of program compilation and debugging, or data analysis as coordinated by TSX when BONER is not in control. The software imple-

mentation of BONER to a multi-laboratory environment for the purpose of maximizing usage of computer resources is discussed. (auth)

7674 (CONF-690301–, pp 287-98) DEVELOPMENT OF A LABORATORY COMPUTER SYSTEM CONCEPT FOR PHYSICS RESEARCH. Heath, R. L.; Black, W. W. (Idaho Nuclear Corp., Idaho Falls).

During the past few years considerable attention has been given to the development of a systems approach to the use of computers in the areas of data acquisition, data analysis, on-line control of experiments, instrumental calibration, and information retrieval. These systems are primarily used in support of research in the areas of nuclear structure physics, neutron physics, and criticality experiments in reactors. The philosophy that has been developed for achieving operational status with minimum cost and the impact of the utilization of such systems on the conduct of research are discussed. The discussion includes descriptions of several typical systems with emphasis on the methods of computer program development, the necessity for the development of specialized hardware, and the utilization of manpower from the many disciplines required to make such an effort successful. The application of interactive display consoles, both remote and hard-wired to data analysis is stressed. The incorporation of some of these computer-controlled experiments into a large central computing facility which includes a million-byte IBM 360/75 with five remote 1130 terminals is also outlined. (auth)

7675 (CONF-690301–, pp 380-93) COMPUTERS AND DEVICES FOR SPECIFIC DATA ACQUISITION FUNCTIONS. Vonderohe, R. H.; Aschenbrenner, R. A. (Argonne National Lab., Ill.).

The wide variety and decreasing cost of computer systems available today have facilitated the automation of data collection and control functions for nuclear physics and similar experiments. At the same time and for the same reasons the actual selection of a particular system has become increasingly difficult. Many of the previous selection characteristics, e.g., core memory size and speed, word length, and price have become of secondary importance to such factors as programming effort required, complexity of the experiment and on-line computational requirements, facility for experimenter intervention, input-output and interrupt requirements, etc. Four unrelated data collection systems are discussed with regard to design objective, degree of fulfillment of that objective, and the impact these systems have had on their respective experiments. Also discussed is the direction in which data collection systems appear to be evolving. (auth)

7676 (CONF-690301–, pp 394-412) MODULAR DATA HIGHWAY SYSTEMS. Senator, A. (Rutgers–The State Univ., New Brunswick, N. J.); Hooton, I. N. (Atomic Energy Research Establishment, Harwell (England)); Miller, G. L.; Lie, H. P.; Gere, E. A. (Bell Telephone Labs., Murray Hill, N. J.).

A survey has been made of the requirements involved in a broad range of on-line computer applications. An examination of a number of detailed cases has indicated that bus or highway oriented systems offer considerable advantages in terms of economics and operating flexibility. In such systems a common set of cables convey address, data, instructions and status signals between the computer, and the on-line equipment. Experience has shown that interconnections between external hardware and the highway can conveniently be made via functionally modular units. Numbers of such systems now exist and have demonstrated their usefulness in a wide range of applications. In experimental nuclear physics such systems offer advantages in data acquisition, display, and experiment control. Several examples are given including the newly standardized European CAMAC modules and the jointly developed Rutgers University-BTL data highway system. (auth)

7677 (CONF-690301–, pp 434-45) AUTOMATIC COUNTING OF TRACKS IN NUCLEAR EMULSIONS. Erskine, John R.; Vonderohe, Robert H. (Argonne National Lab., Ill.).

A scanning machine to process nuclear track plates exposed in a broad-range magnetic spectrograph is now in operation. The system uses a PDP-9 digital computer to do pattern recognition and to control the scanning head. A high-resolution image-dissector tube scans the emulsion with a resolution of about 5 μ. The computer identifies line segments as tracks if they have the proper length and orientation. The machine scans about 50 times as fast as the average scanner. Counting accuracy is found to be influenced by brightness of tracks, fog level in the emulsion, length of tracks, dirt, and number of tracks in a given area. How these and other factors influence the performance of the machine is discussed. (auth)

7678 (CONF-690301–, pp 446-53) SONIC PEN DIGITIZER SYSTEM. Brenner, A. E.; deBruyne, P. (Harvard Univ., Cambridge, Mass. Dept. of Physics).

A sonic pen digitizer for computer graphic display systems which has the capability of digitizing in three dimensions is described. Also, the digitizer system can be used for image plane digitizers for spark chamber film measurements or for predigitizing roads, vertex or clear points for automatic bubble chamber film measuring machines. (W.H.K.)

7679 (CONF-690301–, pp 454-65) THE MIT PEPR SYSTEM FOR MEASUREMENT OF BUBBLE CHAMBER FILM. Yamamoto, R. K.; Bastien, P. L.; Hulsizer, R. I.; Pless, I. A.; Sundberg, R. L.; Taylor, J. P.; Wadsworth, B. F.; Watts, T. L. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

The MIT PEPR system consists of a precision cathode ray tube device connected on-line to a DEC PDP-6 computer. This device is capable of a 2 micron least count and long term stability of one part in 40,000. Operating under Point Guidance mode, 80–100 three-view events of all topologies are measured per hour, including track ionization measurements. The success rate is 80%. (auth)

7680 (CONF-690301–, pp 466-71) MODULAR INSTRUMENTATION SYSTEM FOR COMPUTER AIDED MEASUREMENT AND CONTROL. Hooton, I. N. (Atomic Energy Research Establishment, Harwell (England)).

A system of modular instrumentation, recently adopted by European nuclear laboratories, is based on a standardized highway for data and control signals. The highway acts as a communication path between instrumentation modules, required by the experiment, and controllers which provide an interface to a specific computer. A number of instrumentation modules and controllers developed at A.E.R.E., Harwell, England are described. The use of the controllers with the program controlled and direct store access features of a small computer is discussed. (auth)

7681 (CONF-690301–, pp 484-92) PROGRAMMING LANGUAGE AND PHYSICS RESEARCH. Wells, Mark B. (Los Alamos Scientific Lab., N. Mex.).

Computer language development for experimental nuclear physics is discussed, and examples from a third generation language called Madcap which exists for the Maniac II computer are presented. (W.H.K.)

7682 (CONF-690301–, pp 493-502) FLEXIBLE TASK SCHEDULING SCHEME FOR A REAL-TIME ENVIRONMENT. Mikelsons, M. (IBM Watson Research Center, Yorktown Heights, N. Y.).

A task scheduler of a real-time multiprogramming system is described from the structural point of view. The scheduler was designed to be highly modular to allow full exploitation of user priority independence. A basic resident scheduler performs primitive functions such as task switching and activation of system services. The scheduling algorithm is applied to priority-ordered lists of users. A table of system functions permits general system operations to be treated like normal users. Secondary schedulers may be invoked from the input stream to provide local algorithms for special sets of tasks. Two examples of the scheduler are described in some detail. The A. W. Wright Nuclear Structure Laboratory at Yale University represents a single experiment low-energy physics environment with a requirement for simultaneous background batch processing, while an implementation at the IBM T. J. Watson Research Center represents the multiple experiment situation where several laboratories must be serviced within a set of response and processing time guarantees. (auth)

7683 (CONF-690301–, pp 503-6) MULTIPROGRAMMING SYSTEM FOR REAL-TIME APPLICATIONS. Mikelsons, M.; Summers, P. D. (IBM Watson Research Center, Yorktown Heights, N. Y.).

A highly flexible multiprogramming system for real-time applications is described. The system presents a very simple interface to the user while preserving a high degree of internal flexibility. Each priority level appears to the user as a stand-alone computer protected from all other users of the system. Several modes of dynamic storage allocation control the use of the available memory and provide inter-user communication. Complete priority independence of all users permits dynamic alteration of the priority structure. Two subsystems developed for use at the A. W. Wright Nuclear Structure Laboratory, Yale University, are described to show how the system can be tailored to a particular situation. The data acquisition subsystem permits the writing of real-time programs in an extended version of Fortran. A graphics subsystem permits interactive generation and manipulation of displays. Both subsystems create self-defining data units whose attributes can be changed in real-time. (auth)

7684 (CONF-690301–, pp 507-14) PRECOMPILATION SCHEME FOR THE CREATION OF SPECIAL PURPOSE LABO-

RATORY LANGUAGES. Summers, P. D. (IBM Watson Research Center, Yorktown Heights, N. Y.).

A precompiler for special languages for a real time data acquisition system is described from a structural point of view. The precompiler was designed to be highly modular and to be easily extendable to allow for the creation and evolution of many special laboratory languages. A new statement may be added to an existing language by coding a Fortran subroutine to describe the translation from the new statement to a statement in an existing language, usually Fortran. The coding of this subroutine, called a transform block, is done by using subroutines to perform character manipulation and system interface functions such as input/output. Two examples of this process are described. The nuclear Data Acquisition Language (DAL) has been used for over 18 months for preparing real time data acquisition and analysis programs for low energy nuclear physics at the A. W. Wright Nuclear Structure Laboratory at Yale University and for intermediate energy physics at the NASA Space Radiation Effects Laboratory. The same techniques are currently being used for implementing various languages for automation of a variety of laboratories at the IBM Research Center at Yorktown Heights, N. Y. (auth)

7685 (CONF-690301–, pp 539-51) UTILITY OF CORRELATION METHODS FOR INTERACTIVE DATA REDUCTION AND ACQUISITION. Black, W. W. (Idaho Nuclear Corp., Idaho Falls).

Little effort has been made in the past to utilize the methods of spectral analysis, such as the auto- and cross-correlation functions, in nuclear physics. Recently, applications have appeared in reactor noise measurements and in the development of correlation choppers for time-of-flight experiments. The direct application of spectral analysis methods to data acquisition and reduction in such areas as automatic peak location, cataloging of data and detecting designated components in experimental spectra are discussed. The use of these methods have particular advantage with on-line computer systems, among which are: algorithms that require small amounts of computer memory, a small number of input parameters which are relatively insensitive with respect to the results, and freedom from functional forms when describing experimental characteristics, such as detector response features. Development of some of these techniques are presented, and a discussion given on how they can be utilized in on-line data acquisition and reduction. This discussion centers around user interaction via typical computer peripherals, such as keyboards and display scopes equipped with function boxes and light pens. (auth)

7686 (CONF-690301–, pp 582-603) ECONOMIC ASPECTS OF COMPUTER SYSTEMS IN EXPERIMENTAL NUCLEAR PHYSICS. Fulbright, H. W. (Rochester Univ., N. Y.).

A review is presented on the economic aspects of data acquisition systems used in low and medium energy physics. A simple analysis of the expenditures for on-line computing in a total of 36 different laboratories supported by the AEC and NSF is included. Also, a discussion of the trends in on-line computing facilities for nuclear physics laboratories is given. (W.H.K.)

7687 (COO–1195-174) ULTRA-LINEAR 16-BIT DIGITAL-TO-ANALOG CONVERTER. Zander, Dennis R. (Illinois Univ., Urbana. Dept. of Physics). [1969]. 20 Nov 1969. Dep. CFSTI.

The error analysis and the design of a 16-bit binary digital-to-analog converter are discussed. This method of conversion switches binary-weighted constant current sources into a summing junction, in this case the yoke of a CRT. A conversion linearity of 0.00025% and a stability of 0.0004%/hour were measured for a full scale current of one ampere showing that a converter linear to better than 16-bits can be constructed requiring no trimming of components. (auth)

7688 (ORNL–4459) INSTRUMENTATION AND CONTROLS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 1, 1969. Sadowski, G. S. (comp. and ed.) (Oak Ridge National Lab., Tenn.). Nov 1969. Contract W-7405-eng-26. 154p. Dep. CFSTI.

Separate abstracts were prepared for the 13 sections included. (W.H.K.)

For abstracts of individual sections see: 7630, 7631, 7689–7694, 8785, 8786, 9080, 9147, and 9148.

7689 (ORNL–4459, pp 1-5) PULSE COUNTING AND ANALYSIS. (Oak Ridge National Lab., Tenn.).

Topics include a linear, wide-band, low-noise amplifier stage for use in nuclear pulse amplifiers, pulse shaping for use in pulse amplifiers, a versatile voltage-sensitive preamplifier for use with photomultiplier tubes, a complementary driven quinary ring scaler, tenfold detector gate, balloon neutron spectrometer with remote detector, a two-dimensional position-sensing neutron counting system, low-level gamma-ray spectrometer count-down circuit. (W.H.K.)

7690 (ORNL–4459, pp 6-14) MISCELANEOUS ELECTRONICS DEVELOPMENT. (Oak Ridge National Lab., Tenn.).

Topics include low-level dc preamplifier, safe high-voltage connectors, NIM bin power supply, a potentiostat booster, modification of a commercial function generator, support for the ORNL civil defense group. (W.H.K.)

7691 (ORNL–4459, pp 40-3) AUTOMATIC CONTROL AND DATA ACQUISITION. (Oak Ridge National Lab., Tenn.).

Computer systems for automatic control of an autocorrelation neutron time-of-flight spectrometer, a double-arm sweep-gage inspection machine, a multiple x-ray diffractometer system, a single-axis neutron diffractometer, and a beta spectrometer are briefly described. Also, hard-wired systems for automatic control and data acquisition are briefly discussed. (W.H.K.)

7692 (ORNL–4459, pp 44-56) DATA COLLECTION AND ANALYSIS. (Oak Ridge National Lab., Tenn.).

The development and operation of computer-based data acquisition and control systems at ORNL are outlined. Twenty-six summaries and abstracts of previous reports are presented on various systems. (W.H.K.)

7693 (ORNL–4459, pp 57-78) PROCESS INSTRUMENTATION AND CONTROL. (Oak Ridge National Lab., Tenn.).

Topics include Transuranium Processing Plant, process instrumentation for operating reactors, fermentation pilot plant, plutonium storage facility, sol feed control in a sphere-forming process, high-speed analog data acquisition, environmental chamber, CO_2 analysis of air from animal cages, photometers for biomedical applications, prototype systems for analysis of body fluids, FFTF-LMFBR thermocouple development, LMFBR thermometry program, thermometry for fast breeder reactors, thermocouple speed of response tester, a sensitive temperature-variation detector, automatic remote welding system, programmer for automatic welding, economy programmer, and special valves for a miniature amino acid analyzer. (W.H.K.)

7694 (ORNL–4459, pp 79-84) INSTRUMENT DEPARTMENT MAINTENANCE AND SERVICE. (Oak Ridge National Lab., Tenn.).

Engineering and maintenance activities of the monitoring systems development group, maintenance activities of the computer and analyzer group, special electronics services group, laboratory radio communications systems, electronic services for the neutron physics division, and process control maintenance are briefly discussed. (W.H.K.)

7695 (UCRL–50490) DETERMINATION OF TRANSFER FUNCTION OF SEISMOMETER–TELEMETRY SYSTEM THROUGH USE OF PSEUDO-RANDOM BINARY SEQUENCES. Judd, Deane D. (California Univ., Livermore. Lawrence Radiation Lab.). 16 Jan 1969. 31p. Dep. CFSTI.

Thesis.

A technique used in determining the transfer function of a linear system designed at the Lawrence Radiation Laboratory (LRL) to detect vertical earth motion for determining the explosive yield of nuclear tests is described. The system detects the vertical earth motion at a remote site near Mina, Nevada, and telemeters the information to LRL, Livermore, where it is recorded visibly and on magnetic tape. In brief, the system consists of a long-period vertical seismometer with output signal proportional to velocity, a voltage amplifier followed by a band-pass filter, an FM telemetry system, and a stripchart and/or a magnetic tape recorder. The frequency band of interest is 0.001 to 20 Hz. A procedure for determining the system transfer function, with a pseudo-random binary sequence as input signal, is described, and experimental results giving amplitude and phase characteristics are presented. (auth)

7696 (UCRL–50723) NOISE ANALYSIS IN A SINGLE-TRANSIENT DIAGNOSTIC SYSTEM. Algazi, V. R. (California Univ., Livermore. Lawrence Radiation Lab.). 29 Jul 1969. 19p. Dep. CFSTI.

A fundamental limitation encountered in the acquisition of field data is due to the corruption of the measured signals by noise. The characteristics of the noise in a single-transient diagnostic system for nuclear explosions are described. A simple noise model is proposed and developed in detail and allows for the quantitative evaluation of errors observed in the reconstructed data. (auth)

7697 (UCRL–50735) A GENERAL DESCRIPTION OF THE FALLOUT DISPLAY SYSTEM (FODS). Berndt, Carl W. (California Univ., Livermore. Lawrence Radiation Lab.). 22 Aug 1969. 15p. Dep. CFSTI.

An existing apparatus is described that calculates and displays fallout patterns superimposed on chart or map backgrounds. The fallout pattern is calculated and generated by a small digital computer and memory disc that are incorporated in the machine. Variables to the computer program are readily entered by means of switches and thumbwheels. Fallout patterns can be observed at half-hour increments from detonation through 48 hr. Or the pattern at any time during the first 48 hr may be called up directly. Dose rate and total integrated dose may be read for specific points in any pattern. (auth)

7698 RECEIVER CHANNEL OF A PROTON NMDR SPECTROMETER. Syugis, A.; Alla, M.; Lippmaa, E. Izv. Akad. Nauk Est. SSR, Fiz. Mat.; 18: 313-20(1969). (In Russian).

Nuclear magnetic double-resonance (NMDR) spectrometers set forth special requirements to the NMR signal detecting units, such as high linearity and small zero shift in the presence of strong spurious signals arising under the influence of the strong perturbing rf field H_2. An rf amplifier for time sharing with an rf phase detector of high linearity under double resonance conditions and suitable for line intensity measurements is described. A versatile pulse generator for time sharing has all necessary outputs for driving the transmitter and the receiver. An af phase detector has sufficient dynamic range with high linearity and small zero shift (1 : 2000 in the ±50-V range) and is followed by a resonant RC amplifier-filter which does not affect zero drift. A regenerative LC-filter has been used for the further improvement of measuring accuracy of the NMDR spectra. This filter removes all spurious signals before the af phase detector and is characterized by an effective Q up to 10,000 at 5 kHz, negligible nonlinea ·ity and resonance frequency drift down to 0.01 Hz per hour. The quality of field/frequency regulation of an internal spin stabilizer can be remarkably improved by the use of this filter. (auth)

7699 THEORY OF SPIN STABILIZERS FOR NMDR SPECTROMETERS. FREQUENCY RESPONSE. Syugis, A. Izv. Akad. Nauk Est. SSR, Fiz. Mat.; 18: 304-12(1969). (In Russian).

NMDR spectrometers require very fast stabilizers. For that reason, stabilizers with frequency regulation are considered. An integrated block diagram is given for a passive spin stabilizer, for a spin generator with automatic phase control, and for a spin generator with automatic frequency control. On the basis of structural diagrams, expressions of the coefficients of stabilization are derived for a spin generator without control and for the kinds of spin stabilizers mentioned above. An analysis of the conditions of self-excitation and critical damping is carried out. Plots of the critical conditions and frequency dependence of the coefficients of stabilization are presented. (auth)

7700 RADIATION SHIELDING FOR THE MRC HIGH-TEMPERATURE DIFFRACTOMETER ATTACHMENT. Taylor, G. F. (Commonwealth Scientific and Industrial Research Organization, North Ryde, Australia). Aust. Electron. Eng.; 2: 28-9 (Jul 1969).

A description of protective radiation shielding for the MRC High-Temperature Attachment when mounted on a Philips PW 1050/25 Wide-Range Goniometer is presented. The protective shielding can be made cheaply in an average workshop and requires no alteration to the high-temperature attachment or the goniometer. (Australia)

7701 STUDY ON PERMANENT-MAGNET FLOWMETER FOR LIQUID SODIUM. II. EXPERIMENT. Kobayasi, Kiyosi; Kudo, Akio; Furukawa, Kazuo; Nihei, Isao; Yamamoto, Ken. (Tohoku Univ., Sendai). Nippon Genshiryoku Gakkaishi; 11: 716-20(1969). (In Japanese).

Experimental results obtained on a liquid sodium electromagnetic flowmeter are described. Using a calibrating loop, the performance of the electromagnetic flowmeter was measured in terms of flow rate, sodium temperature (200° ~ 500°C), and sodium purity. The flowmeter output calculated in the previous report was in good agreement with the experiments. (auth)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstract 9079.

Basic Processes

7702 (RLO-2213-1) ECOLOGICAL TECHNIQUES UTILIZING RADIONUCLIDES AND IONIZING RADIATION. A Selected Bibliography. Schultz, Vincent (Washington State Univ., Pullman. Dept. of Zoology). Dec 1969. 252p. Dep. CFSTI.

A bibliography is presented of the techniques utilizing radionuclides and ionizing radiation developed by freshwater, marine, and terrestrial ecologists as well as scientists in closely related fields. The 3081 references cited were obtained from earlier bibliographies and NSA. The citations are arranged in alphabetical order according to the author's name. Where possible, the tracer used in the study is listed and, where possible, the original, non-English, language of the citation is given. (E.R.B.)

7703 QUANTITATIVE ASPECTS OF THE MEASUREMENT OF NATIVE SECRETION GRANULE INSULIN. Steffes, Michael W.; Sorenson, Robert L.; Lindall, Arnold W. (Minneapolis Medical Research Foundation). J. Lab. Clin. Med.; 74: 950-60 (Dec 1969).

Standard pork and rat crystalline insulin and fractions of rat islet of Langerhans were assayed for insulin content by the radioimmunoassay method. The results indicated that equal amounts of the crystalline insulin used in the standard preparations and the insulin present in the tissues assayed did not produce equal responses as measured by immunoassay, a finding that reflected unequal competition of the insulin present in the standards or tissues with the ^{125}I-labeled porcine insulin used as a tracer. The use of crystalline insulin of either kind as a standard to measure insulin in tissue resulted in an underestimation of the amount of insulin present. The pork standard created the greatest discrepancy when used in the measurement of insulin in rat tissue samples. A method is described that will estimate the amount of insulin present in tissue. The results of this method agreed closely with a method of estimating insulin content by electrophoresing the samples on polyacrylamide gels, staining, and scanning the gels. (auth)

7704 FOLLICLE-STIMULATING ACTIVITY OF HUMAN CHORIONIC GONADOTROPIN. Albert, A. (Mayo Clinic, Rochester, Minn. Mayo Graduate School of Medicine, Rochester, Minn.). J. Clin. Encocrinol. Metab.; 29: 1504-9(Nov 1969).

Preparations of human chorionic gonadotropin (HCG) of low, moderate, and high HCG purity were studied qualitatively and quantitatively for their follicle-stimulating hormone (FSH)-like activity (FSA). It was found that despite a 7-fold increase in potency and purity of HCG, the FSA was not removed, indicating that FSA was not due to contamination with pituitary FSH, but rather represented an intrinsic property of HCG itself. Subsequent studies in hypophysectomized rats confirmed the intrinsic nature of FSA in HCG rather than the result of pituitary stimulation by high-activity HCG. Radioimmunoassay for FSH in HCG preparations also confirmed the hypothesis that FSA was an intrinsic property of HCG. (E.R.B.)

7705 CORRELATION BETWEEN BIOLOGICAL AND IMMUNOLOGICAL POTENCIES OF HUMAN SERUM AND PITUITARY THYROTROPIN. Miyai, Kiyoshi; Fukuchi, Minoru; Kumahara, Yuichi (Osaka Univ.). J. Clin. Endocrinol. Metab.; 29: 1438-42(Nov 1969).

Thyrotropin concentrations in sera of patients with hypothyroidism before and after administration of thyroid hormone, and in human pituitary preparations of varying degrees of purity, were determined by bioassay and immunoassay. When each value obtained by the McKenzie bioassay (B) was plotted against that obtained by radioimmunoassay (I), a linear relationship was found between them. However, the ratio of B/I was 5.6 in sera and 4.6 in the pituitary preparations when Human Thyrotrophin Research A was used as a standard in both assays. (auth)

7706 MEASUREMENT OF β-EMITTERS IN PLANT MATERIAL WITH CHERENKOV RADIATION: CORRECTION OF COLOR-QUENCHING. Brownell, J. R.; Lauchli, A. (Univ. of California, Davis). Int. J. Appl. Radiat. Isotop.; 20: 797-8(Nov 1969).

It is stated that Čerenkov radiation is used routinely in the authors' laboratory for measuring the β-emitters ^{86}Rb and ^{36}Cl in intact plant material. In such work information is also needed on total contents of non-radiative ions. For determining both total and radioactive Rb a nitric acid ashing procedure is adopted, and this leads to a yellow colored digest which is a source of color-quenching in Čerenkov radiation measurement. Quenching in liquid scintillation counting is corrected by automatic external standarization, and it was considered that such standardization should also be applicable to the correction of color-quenching with Čerenkov radiation. Some tests with ^{86}Rb in plant material are described. Without external standardization count rates for plant samples indicated recoveries of approximately 50%, but with external standardization recoveries were about 100%. Recommendations are also made with regard to soft β-emitters such as ^{36}Cl. (auth)

7707 USE OF ^{85}Sr FOR THE DETERMINATION OF THE CONTRIBUTION OF DIRECT AND INTESTINAL ABSORPTION OF Ca AND Sr IN A FRESHWATER FISH. Berg, A. (EURATOM, Ispra, Italy). pp 325-38 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Calcium and strontium exchanges were studied experimentally in Carassius auratus under conditions of zero growth. The study showed the major importance of water under these conditions, and the effect of the calcium and strontium content of the water and food. (auth)

7708 FEEDING RATES OF FRESHWATER SNAILS (GONIOBASIS CLAVAEFORMIS) DETERMINED WITH ^{60}Co. Malone, C. R.; Nelson, D. J. (Oak Ridge National Lab., Tenn.). Ecology: 50: 728-30(Summer 1969).

A short-term radioisotope method was developed for estimating feeding rates of snails inhabiting freshwater streams. Snails were allowed to feed for 1 hr on the surfaces of rocks previously soaked in a ^{60}Co solution. Organic detritus and aufwuchs were scraped from the rocks and assayed to determine radioactivity. When the dpm of ^{60}Co/mg^{-1} of food was known, the quantity of biomass ingested by the snails could be calculated by determining the radioactivity in the snails. Feeding rates varied both diurnally and monthly, suggesting periodicity in feeding activities and interactions with environmental factors. (auth)

7709 RADIOASSAY FOR SERUM VITAMIN B_{12} WITH THE USE OF SALIVA AS THE VITAMIN B_{12} BINDER. Carmel, Ralph; Coltman, Charles A. Jr. (Aerospace Medical Lab., San Antonio. Wilford Hall Air Force Medical Center, Lackland, AFB, Tex.). J. Lab. Clin. Med.; 74: 967-75(Dec 1969).

A rapid, easy radioimmunoassay for serum vitamin B_{12} is described. Saliva, a readily available, rich source of vitamin B_{12}-binding protein, is used. The assay is reproducible, correlates satisfactorily with microbiological assay results, and clearly differentiates between B_{12}-deficient, normal, and high-B_{12} sera. Poor exclusion by some hemoglobin-coated charcoals of saliva-bound B_{12} in the absence of serum resulted in falsely low results. This problem can be corrected by acidification and redrying of the charcoal powder prior to coating or circumvented by additional coating of the hemoglobin-coated charcoal with vitamin B_{12}-saturated serum. (auth)

7710 MECHANISM OF SPECIFICITY IN RADIOIMMUNOASSAY FOR HUMAN FSH AFTER HCG ADSORPTION OF ANTISERA. Faiman, Charles; Ryan, Robert J. (Univ. of Manitoba, Winnipeg, Can. Mayo Clinic, Rochester, Minn.). Proc. Soc. Exp. Biol. Med.; 132: 691-5(Nov 1969).

Three lines of evidence are presented that show that the mechanism whereby the addition of human chronic gonadotropin (HCG) confers follicle-stimulating hormone (FSH) specificity on the FSH radioimmunoassay is by adsorbing out a species of antibodies that fails to distinguish among the glycoprotein hormones, FSH, LH, and HCG, leaving a second species of FSH-specific antibodies to react with the FSH label in the system. (auth)

Metabolism, Physiology, and Toxicology

Refer also to abstracts 7775–7777, 7782, 7786–7788, 7791, 7796, 7859, 7863, 7869, and 7941.

7711 (AD-694531) EXPERIMENTAL INVESTIGATION OF PLANT UPTAKE CONTAMINATION FACTORS. Final Report. Sartor, James D.; Kruzic, Pamela G.; Lane, William B.; Mackin, James L. (Stanford Research Inst., Menlo Park, Calif.). Sep 1968. Contract N00228-67-C-2036. 152p. (USNRDL-TRC-68-57). CFSTI.

The uptake of four radionuclides ^{85}Sr, ^{106}Ru, ^{137}Cs, and ^{144}Ce was measured for four plants (wheat, tomatoes, corn and potatoes) grown in four different soil types (sandy loam, sandy clay loam, silty clay and clay). Plants were grown in large soil containers that allowed most of the root system to develop under normal field conditions. Plant uptake contamination factors (aSU) were calculated for each sample harvested. Comparisons of the uptake for various plant part-soil-radionuclide combinations at crop maturity showed that the aSU values for Sr-85 were the largest in all instances, usually by an order of magnitude. The aSU values for the edible portion of each plant were lowest in every case, and usually the leafy portions of the plants had the largest aSU value. Additional experiments included measurements of changes in radionuclide uptake caused by available calcium levels, growing crops in large fields, and contaminant form and solubility. (auth) (CFSTI)

7712 (GJO-932-2) RELATIONSHIP OF MICROORGANISMS TO URANIUM DEPOSITS. Final Report. Updegraff, David M. (Denver Research Inst., Colo.). 11 May 1969. 73p. (DRI-2498). Dep. CFSTI.

Microbiological studies were carried out on 63 samples of uranium ore and associated sediments collected from three different areas: Grants, New Mexico, Gas Hills, Wyoming and Uravan area, Colorado. The conclusions from these studies may be summarized as follows: The samples contained remarkably few microorganisms, as well as very few different kinds of microorganisms compared to what would be found in surface soil samples. Some samples contained no detectable microorganisms at all in a 1 g sample. Seventy-two percent of the pure cultures isolated belonged to the genus Arthrobacter. Other bacterial genera identified were Bacillus and Streptomyces. No obligate or facultative anaerobes were found. Ferrobacillus and Thiobacillus were not found. Fungi were found in occasional samples only. The most abundant genus was Penicillium. There was no significant difference in flora between samples high in uranium and those low in uranium. There is no indication from these studies that microorganisms can be used as a geomicrobiological prospecting tool for uranium, but it is likely that microorganisms had a good deal to do with the original migration and deposition of uranium. (C.O.)

7713 UPTAKE OF ^{65}Zn, ^{115}Cd, AND ^{203}Hg BY FRESHWATER PLANTS AND EFFECTS OF EDTA ON THE CONCENTRATION OF THESE ISOTOPES. Makhonina, G. I.; Gileva, E. A. Tr. Inst. Ekol. Rast. Zhivotn.; No. 61, 72-8(1968). (In Russian).

The coefficients of accumulation of ^{65}Zr, ^{115}Cd, and ^{203}Hg by freshwater plants are very large and are measured by thousands, sometimes by tens of thousands. The addition of these elements to solutions in the form of chelate complexes with EDTA decreases their accumulation by freshwater plants. (tr-auth)

7714 PLANT UPTAKE OF MICROQUANTITIES OF ^{91}Y AND ^{144}Ce FROM NUTRITIVE SOLUTIONS AND SOIL. Molchanova, I. V. Tr. Inst. Ekol. Rast. Zhivotn.; No. 61, 31-4(1968). (In Russian).

Following a study of the uptake of microquantities of ^{91}Y and ^{144}Ce by pea and barley plants from nutrient solutions and soils, their distribution in plants was established. The mobility of ^{91}Y was greater than that of ^{144}Ce. The transport of yttrium by plants and the coefficients of its accumulation in the above-ground parts of the plants were several times greater than these quantities for cerium. Yttrium-91 and ^{144}Ce that were taken up by plants from nutrient solutions, were accumulated mainly in roots. Following uptake from soil, an evener distribution of the radioisotopes in the plant was noted. (tr-auth)

7715 EFFECTS OF SOIL MOISTURE ON THE DISTRIBUTION OF ^{35}S IN THE BASIC GROUPS OF CHEMICAL COMPOUNDS OF PEA AND PINE PLANTS. Karavaeva, E. N. Tr. Inst. Ekol. Rast. Zhivotn.; No. 61, 61-4(1968). (In Russian).

Most of the ^{35}S from soil acting in pea plants and pines, was contained in water-soluble compounds. The distribution of ^{35}S among the main groups of chemical compounds depended on the specific peculiarities of the plants. The degree of soil moisture had little effect on the distribution of ^{35}S among the fractions of the chemical compounds of the pea plants and pines. (tr-auth)

7716 INFLUENCE OF EDTA ON THE COBALT MOBILITY IN ABOVE GROUND PEA PLANTS. Chebotina, M. Ya. Tr. Inst. Ekol. Rast. Zhivotn.; No. 61, 55-7(1968). (In Russian).

The outflow of ^{60}Co from leaves and other organs of pea plants following root feeding with a solution of $^{60}CoCl_2$ was approximately three times greater than following feeding with a solution of ^{60}Co-EDTA. The relative distribution of cobalt in the main organs of the pea plants following uptake of either solution was the same. The transfer of cobalt from the nutrient solution to the root system of the plants was not revealed. (tr-auth)

7717 INTERACTIONS OF ^{233}Pa WITH TISSUES OF MYTILUS GALLOPROVINCIALIS AND CARCINUS MEDITERRANEUS. Lucu, C.; Jelisavcic, O.; Lulic, S.; Strohal, P. (Inst. Ruder Boskovic, Zagreb). Mar. Biol., 2: 103-4(Feb. 1969).

Uptake of ^{233}Pa from sea water by tissues of mussels M. galloprovincialis and crabs C. mediterraneus was studied. The high values of the contamination factor found in digestive tract, gills, and skeleton of both of these species and increase of the contamination factor in byssus of mussels are the consequence of radionuclide surface adsorption on the tissues. In the mussel the maximal contamination factor in byssus was about 2500, while in the shell it did not exceed 150. Contamination factors in the equilibrium state ranged from 100 to 200 in the digestive tract. Since the gills filter the sea water, they showed a higher contamination compared with reproductive system and muscle tissue. In the crab the contamination factor was 2500 for the gills, while in skeleton and digestive tract (gut, hepatopancreas) it was lower, i.e., less than 200. Reproductive system and muscle had the lowest values (5 to 20), while the hemolymph was practically uncontaminated. The complexon EDTA (ethylenediaminetetraacetic acid) had no effect on the degree of contamination of the mussels and crabs. (BBB)

7718 EFFECT OF VASOPRESSIN INFUSIONS ON THYROIDAL RADIOIODINE UPTAKE AND SERUM TSH CONCENTRATION. Read, Dale G.; Hershman, J. M.; Pittman, J. A. Jr. (Veterans Administration Hospital, Birmingham, Ala. Univ. of Alabama, Birmingham). J. Clin. Endocrinol. Metab.: 29: 1496-8(Nov 1969).

Ten normal male volunteers in which there was no evidence of thyroid dysfunction and in which the protein-bound iodine (PBI) and thyroxine (T_4) values were within normal limits, were used to determine the effects of vasopressin infusions on thyroidal ^{131}I uptake and serum thyroid-stimulating hormone (TSH) levels. Following the determination of the baseline 2, 4, 6, and 24 hr thyroid ^{131}I uptake and serum TSH levels, daily 8 hr infusions of 5 pressor units of vasopressin in 500 ml of 5% dextrose were administered for three successive days. The results indicated that vasopressin, as administered, did not cause stimulation of the thyroid gland in intact subjects, as estimated by ^{131}I uptake, nor did it increase secretion of pituitary TSH, as reflected in serum TSH concentrations. In fact, a slight but significant decrease in thyroidal ^{131}I uptake was noted. (E.R.B.)

7719 CHANGE IN THE PHYSICAL CHEMICAL STATE OF RADIONUCLIDES IN SEA WATER AND ITS INFLUENCE ON ACCUMULATION BY MARINE ORGANISMS. Zesenko, A. Ya.; Lyubimov, A. A.; Ivanov, V. N.; Leshchenko, L. H. Okeanologiya, 8: 1092-3(1968). (In Russian).

Since different chemical forms of the same element will be absorbed by marine organisms at different rates, the incorporation of radioisotopes will be non-uniform and will depend on the physical chemical state of the compounds absorbed. Such effects in the conversion of radioyttrium were studied. Methods of adsorption on artificial adsorbents were used, the models being filter paper, polyethylene, and Ftoroplast-4. In parallel studies with Ulva rigida and Mytilus galloprovincialis problems of accumulation of ^{90}Sr by biological specimens as a function of the physical chemical state were studied. The significance of alterations of the physical and chemical states of radionuclides is discussed in light of results for artificial and actual systems for radioecological problems. (BBB)

7720 STRONTIUM IN MAN. Loutit, J. F. (Medical Research Council, Harwell, Eng.). pp 27-33 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Bones obtained at post-mortem were examined for ^{90}Sr and natural Sr since 1956. From the accumulated data combined with estimates of strontium in diet calculations have already been made, and will be brought up to date, of the annual rate of replacement of strontium in the body of children (a high value ~50%) and adolescents (a low value about 15%). In recent years more attention has been paid to adults from which it is deduced that replacement of ^{90}Sr and Sr is considerably greater than formerly credited. (auth)

7721 DEPOSITION PATTERNS OF BONE-SEEKING ISOTOPES IN MAN. Rowland, R. E.; Lloyd, Elizabeth (Argonne National Lab., Ill.). pp 63-72 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The long-term hazards to man arising from environmental contamination by radioactive materials are usually associated with those radioactive materials that deposit and remain within bone. The magnitude of the hazard depends, to a first approximation, upon the actual quantity of the radioisotope deposited within the skeleton. However, the localization within bone, the so-called deposition pattern, is also of great significance in the toxicity of various bone-seeking isotopes. Unfortunately, very little quantitative information is available regarding the deposition patterns of most isotopes in human bone. However, ^{226}Ra deposition patterns have been studied in human bone at periods up to 40 years after intake, and these can be used to predict distribution patterns for other bone-seeking isotopes. The microscopic distribution of ^{226}Ra in a number of recently examined cases is examined. The study of these cases has demonstrated the importance of age and of the duration of the exposure upon the microscopic distribution pattern. Since ^{90}Sr is known to be deposited in the same sites in bone as ^{226}Ra, it should be possible for a given contamination situation, to give an indication of the dose distributions to be expected from the exposure. This approach is not valid for other bone-seeking isotopes, such as plutonium and americium, which deposit on bone surfaces. For contamination situations involving these isotopes, approximation of the expected dose distributions requires knowledge of the available surface within the skeleton. This information was recently acquired from our measurements of the surface-to-volume ratios of various human bones. (auth)

7722 SPECIES DIFFERENCES IN THE ^{210}Po METABOLISM IN LABORATORY ANIMALS. Parfenov, Yu. D.; Poluboyarinova, Z. I. (Inst. of Biophysics, Moscow). Radiobiologiya; 9: 596-8 (Jul-Aug 1969). (In Russian).

Investigations of the species differences in the dynamics of ^{210}Po metabolism were conducted on dogs, rabbits, and rats. Polonium-210 was administered in a single subcutaneous injection to rats at doses of 0.01, 0.03, 0.035, and 0.075 μCi/g, to rabbits at a dose of 0.04 μCi/g, and to dogs at doses of 0.0025 to 0.5 μCi/g. Data on the ^{210}Po metabolism in the mouse organism were used from the work of Finkel et al. (1953) on intravenous injection of the isotope. The results of the experiments indicated that ^{210}Po is eliminated from various organs of rabbits more rapidly than from the same organs of mice, rats, and dogs. Species differences in the levels of accumulation of ^{210}Po in various organs and tissues were noted: in the kidneys in rabbits, in the spleen in dogs, as well as in other organs. (tr-auth)

7723 INFLUENCE OF VACCINATION ON THE INTENSITY OF DEPOSITION OF ^{90}Sr RADIOACTIVE STRONTIUM IN RABBITS. Torchinskaya, O. L.; Klemparskaya, N. N.; Razumovskii, N. I. (Inst. of Biophysics, Moscow). Radiobiologiya; 9: 647-9 (Jul-Aug 1969). (In Russian).

It was shown in experiments on rabbits that active immunization by tetravaccination intensifies strontium metabolism. In this case, grafts performed before the incorporation of radiostrontium increased its accumulation in the skeleton. In the case of stabilization of the process of deposition of ^{90}Sr in an organism with normal reactivity, vaccination produces a substantial release of this element from the skeleton. (tr-auth)

7724 SURVEY OF RADIOLOGY, SCINTIGRAPHY, AND BIOPTICS OF NEOPLASTIC LESIONS IN SKELETAL STUDIES WITH RADIOSTRONTIUM (^{85}Sr). Trinci, M.; Cantarano, G.; Centi Colella, A.; Pigorini, F. (Univ., Rome). Nunt. Radiol., 33: 1191-1200(Oct. 1967). (In Italian).

Modalities of fixation of strontium in the bony newgrowths, established by means of scanning and of both autoptic and bioptic examinations are reported. There seems to be no relationship between the capacity of isotope uptake and the osteoblastic or osteoclastic character of lesions, as established by x-ray examination. However, osteoblastic newgrowths show a more marked fixation of the tracer. This fixation is conditioned essentially by the degree of bony fraction. The histological picture of the lesions that show a marked uptake of radioactive strontium is characterized by presence of bony trabeculae surrounded by large borders of osteoid tissue, which is the result of bony newgrowth in the active stage. The particular avidity of strontium by this tissue, consisting essentially of a proteinic matrix, confirms the observed relationship between the amount of this reaction tissue and the fixation degree of the radioactive strontium. (H.B.G.)

7725 EFFECTS OF THIOCYANATE ON IODINE METABOLISM IN BOVINE. Moss, Buelon Rexford. Knoxville, Tenn.; Univ. of Tennessee (1968). 133p.

Thesis.

Effects of SCN on radioiodine metabolism were investigated in normal and athyroid (either surgically or radioiodine thyroidectomized) cows and calves. Both control and athyroid animals, with the exception of one athyroid animal, had higher radioiodine excretion in the urine during the period when 2 to 5 g of NaSCN were fed than during the preliminary period. Daily SCN administration caused a decrease in radioiodine excreted in the feces when radioiodine was given as a single dose, but did not affect fecal excretion when a daily dose was given. The plasma radioiodine concentration was higher for both athyroid and normal animals when SCN was fed than during the preliminary periods. The increase in plasma radioiodine concentration and the higher urinary radioiodine excretion in both normal and athyroid animals when SCN was fed indicated that the effect of SCN was not dependent on blockage of thyroid competition for circulating iodine. The higher plasma radioiodine concentration in both normal and athyroid animals suggested that the increased urinary radioiodine excretion was due to the elevated plasma levels with consequent greater elimination in the urine. Thiocyanate administration significantly increased the radioiodine clearance, but did not alter the urine flow. This showed that increased urinary radioiodine excretion could occur without higher plasma levels during the SCN period. A simultaneous metabolism of iodide (^{131}I) and triiodide ($^{125}I_3$) in calves resulted in slightly less ^{125}I than ^{131}I excretion in the urine and feces with a slightly lower ^{125}I concentration in plasma. The excretion pattern of the ^{125}I was not similar to the radioiodine excretion patterns after SCN administration and, therefore, eliminated the possibility of an abnormal I_3^- formation and subsequent excretion upon the administration of SCN to cattle. Two calves received a simultaneous transfusion of plasma from each of two calves dosed with either 15 mCi of ^{131}I or of ^{125}I plus NaSCN. The excretion patterns of ^{131}I and ^{125}I in the transfused calves were identical, but significantly less ^{125}I than ^{131}I was taken up by the thyroid. If the SCN in the transfused plasma was sufficient to cause a decrease, it would have affected both ^{131}I and ^{125}I identically. Since this did not happen, the results indicated that SCN altered the ^{125}I in some manner to make it less available for thyroid uptake. The higher thyroid uptake of ^{131}I than ^{125}I suggested that SCN caused the formation of an abnormal iodine compound in the blood which was not concentrated by the thyroid. However, the lack of a concurrent difference in the urinary excretion pattern between the two isotopes makes it difficult to assess the significance of the thyroid results. (TSS) (Disser. Abstr.)

7726 EFFECTS OF PHENYLEPHRINE, BUTYLSYMPATOL, PILOCARPINE, AND LITHIUM ON RUNOUT OF ^{86}Rb FROM ISOLATED RABBIT CILIARY PROCESSES. Vale, Janet (Univ. of Manchester, Eng.); Barany, Ernst H. Invest. Ophthalmol., 8: 422-33(Aug. 1969).

Isolated ciliary processes from pigmented rabbits were exposed to ^{86}Rb, washed, and transferred to a runout medium. The ciliary processes were incubated for 30 min in 3 ml of fluid containing 1 μCi of ^{86}Rb. The concentration of stable Rb was below 1 m$\underline{M}$. The appearance of ^{86}Rb in inactive medium was followed. Uptake of ^{86}Rb was decreased by lack of glucose and/or oxygen, and by 10 times excess K. Runout was decreased by cold (+10°C) and by 3 or 30 m$\underline{M}$ Ca, and increased by complete substitution of Li for Na. Pilocarpine (10^{-3} or 10^{-5} $\underline{M}$) had a small accelerating effect limited to the initial phase of runout, while the stable β-adrenergic agent butylsympatol (10^{-3} $\underline{M}$) in the presence of 2 m$\underline{M}$ Ca had a very small but more long-lasting accelerating effect. The α-adrenergic phenylephrine (10^{-2} $\underline{M}$) had no effect. (BBB)

Radiation Effects

Refer also to abstracts 7805, 7806, 7933, 7976, and 8035.

7727 (AECL-3374) BIOLOGY AND HEALTH PHYSICS DIVISION PROGRESS REPORT, JANUARY 1-MARCH 31, 1969. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). 39p. (PR-B-81). Dep. CFSTI (U. S. Sales Only).

Research conducted by the Biology and Health Physics Division of the Chalk River Nuclear Laboratories is summarized. The summaries are categorized into: Biology, including biochemistry and molecular biology and genetics, development and population studies; Environmental Research Studies, including off-site monitoring, liquid radioactive waste disposal, fission product studies in freshwater ecosystems, and meteorology; and Health Physics

Reports, including neutron dosimetry, tritium detectors, health physics instrumentation, display systems, and routine dose monitoring. The staff of each department and the papers published from each department for the report period are also given. (E.R.B.)

7728 (BNL-14124) DOSE TO THE CELL NUCLEUS FROM TRITIATED THYMIDINE. Johnson, Horton A. (Brookhaven National Lab., Upton, N. Y.). 3 Nov 1969. 13p. (CONF-691201-1). Dep. CFSTI.

From Symposium on Medical Radionuclides: Radiation Dose and Effects, Oak Ridge, Tenn.

Tritiated thymidine appears to be amenable to the same dosimetric considerations as apply to other internal emitters. The β dose rate to the cell nucleus, calculated as the rate of energy absorption per unit mass, is compatible with observed biological effects. There seems to be no special hazards due to radiation arising in the genetic material or due to elemental transmutation in DNA. The cumulative doses to cell nuclei are more difficult to estimate, being subject to the uncertainties and variability of the generative cycle. For a given tissue concentration of ^{3}H, specific incorporation into DNA increases the dose rate to nuclei of labeled cells, but selective uptake by cells in the S phase tends to decrease the overall radiation effect on the tissue as a whole. The minimum dose of tritiated thymidine at which a variety of radiation effects become manifest in rodents is of the order of 1 μ Ci/g of body weight. This corresponds roughly to an initial activity per nucleus of 28 disintegrations per day or about 8 rads per day for a nucleus 8 μ in diameter. (auth)

7729 (CEA-Bib-162) EXCITED STATES IN MOLECULES OF BIOLOGICAL INTEREST. Nounou, Pierre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Oct 1969. 28p. (In French). Dep. CFSTI (U. S. Sales Only).

The knowledge of excited states and of their distribution, first of radiations on biological molecules enables us to understand the radiations effect on the living substances. Among different types of allowed states of a molecule, the triplet states and the different theories which can explain most of radiation-less transitions were studied. The following theories were considered: phonon-theories; exciton-theories, properly about helicoidal polynucleotids; phosphorescence; and photochromic effect. In a last part, a brief description of the principal experimental designs which allow an observation of the effects described above, and especially of flash-photolysis and flash-spectroscopy was given. (auth)

7730 ENDONUCLEOLYTIC CLEAVAGE OF UV-IRRADIATED DNA CONTROLLED BY THE V^{+} GENE IN PHAGE T4. Friedberg, Errol C.; King, John J. (Walter Reed Army Inst. of Research, Washington, D. C.). Biochem. Biophys. Res. Commun., 37: 646-51(Nov. 6, 1969).

Extracts of E. coli infected with bacteriophage T4 contain a phage-induced uv-specific endonucleolytic activity. This activity is absent from extracts of cells infected with the uv-sensitive mutant T4V1, but is present in another uv-sensitive mutant T4X. (auth)

7731 FORMATION OF SUGARS IN THE WOOD OF FAGUS SILVATICA L. IRRADIATED BY ^{60}Co GAMMA RAYS. Bonotto, S.; Millic, G. (CEN, Mol, Belgium). Radiat. Bot.: 9: 375-8 (Oct 1969). (In French).

The presence of several sugars found by paper chromatography in the extract of gamma-irradiated wood of Fagus silvatica L suggests a possible mechanism of depolymerization of the polysaccharidic chains (celluloses and hemicelluloses) and probably a further degradation of the sugars thus formed to monoses of lower molecular weight (pentoses, tetroses and trioses). (auth) (UK)

7732 BLASTOGENESIS OF LYMPHOCYTES INDUCED BY PPD-PRIMED X-IRRADIATED AUTOLOGOUS LYMPHOCYTES. Kasakura, Shinpei (Royal Victoria Hospital, Montreal, McGill Univ., Montreal). J. Immunol.; 103: 1078-84(Nov 1969).

Heavily x irradiated human lymphocytes that were incubated with tuberculin-purified protein derivative (PPD) at 37°C and then washed thoroughly induced blast cell transformation of intact, autologous leukocytes. This did not occur with cells from tuberculin-negative subjects. PPD-primed, 10,000 R irradiated cells induced blastogenesis. Irradiated cells primed at 4°C also induced blastogenesis. The degree of blastogenesis was affected by the ratio of the number of PPD-primed irradiated cells to the number of intact, autologous leukocytes; the PPD concentration used for priming; the radiation dose; the temperature during incubation with PPD; and the length of incubation with PPD. Our present data suggest that PPD may be bound physically to the surface of cells (probably lymphocytes) and may stimulate intact, autologous leukocytes through direct cell-to-cell contact. (auth)

7733 MEASUREMENTS OF VASCULAR PERMEABILITY, BLOOD SUGAR, AND CATECHOLAMINES IN RABBITS EXPOSED TO X RAYS AND RADIAL ACCELERATION. Lazar, A. F. (Inst. of Medicine, Kiev). Med. Radiol.; 13: No. 2, 84-6(Feb 1968). (In Russian).

Change of permeability of vessels, the content of sugar and catecholamine in the blood of rabbits following the action of x rays and radial acceleration. An analysis of the results of calculations of dose distribution showed that an increase in the angle of the slope of the tube leads to significant improvement in isodose distributions. The best result was obtained at a 45° angle of slope. Further increase of the angle leads to an increase of the absorbed dose in vital organs, i.e., lungs, spine, trachea. The length and width of the fields were selected individually in relation to the clinical state of the patient. (tr-auth)

7734 BIOSYNTHESIS OF OVERALL AND INDIVIDUAL PROTEINS IN ENDOCRINE GLANDS OF IRRADIATED ANIMALS. Molotkov, O. V.; Grodzenskii, D. E.; Bezdrohnyi, Yu. V. (Inst. of Medical Radiology, Erevan. Radiation Immunology Inst. Epidemiology and Microbiology, Erevan). Med. Radiol; 13: No. 5, 47-53(May 1968). (In Russian).

The data do not confirm previous reports concerning the effects of ionizing radiation as a nonspecific stress on the stimulation of ACTH production. In the internal secretion glands of irradiated animals, the biosynthesis of proteins was altered or inhibited. This disturbance was most expressed at the height of radiation sickness. Inhibition of the synthesis of proteins in the hypophysis on the fifth day after irradiation was reflected in a reduction of the synthesis of ACTH and somatotropic hormone (STH). In the hypophysis of irradiated animals there is essentially no inhibition of the activity of the enzymes responsible for the synthesis of the two protein hormones, ACTH and STH. In irradiated organisms there is essentially no inhibition of the mechanism of action of STH and 19-NOR-D-Testosterone. Application of these hormones leads to a reduction of the effect of ionizing radiation on the processes of catabolism. STH promoted the normalization of protein synthesis in the endocrine glands studied. (tr-auth)

7735 EARLY CHANGES OF PROTEIN-BOUND IODINE, BUTANOL-EXTRACTABLE IODINE, CONVERSION FACTOR, AND RADIOACTIVE PROTEIN-BOUND IODINE DURING TREATMENT OF THYROTOXICOSIS AND THYROID CANCER WITH ^{131}I. Bednar, J.; Nemec, J.; Soutorova, M.; Roehling, S. (Research Inst. of Endocrinology, Prague). Nucl.-Med.; 8: 256-65(31 Oct 1969).

The interval after which damage of the thyroid following the administration of therapeutic doses of ^{131}I is manifested by changes in the concentration of iodine substances in blood differs depending on the type of estimation, the type of thyroid disease on individual radiosensitivity, the functional state of the thyroid, and the amount of energy absorbed by the thyroid. Protein-bound iodine (PBI) and butanol-extractable iodine (BEI), during therapy, underwent different changes in individual patients but during the early period after administration (within five to six weeks), they did not change fundamentally in thyrotoxicoses. After thyroid ablation in cancer patients, the declining trend of PBI was more marked following a temporary increase. A decline of the PBI and BEI concentration in blood occurs only after a certain period following ^{131}I therapy. It was most marked in thyroid cancer where in the majority of patients controlled eight to twelve weeks following administration the PBI values were less than 4 $\mu g\%$ and the BEI concentration was very low or could not be detected at all. Interesting differences were manifested in the PB ^{131}I level in both subgroups of hyperthyroid patients (metabolic and cardiac form) that may prove important from the diagnostic aspect. The explanation of the observed phenomena is discussed in detail. (auth)

7736 CONTENT OF FREE AND BOUND AMINO ACIDS BOUND TO THE RING OF THE TRICARBONIC ACIDS IN THE BRAIN FOLLOWING X IRRADIATION. Dovgalevich, I. I.; Pikulev, A. T. Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk; No. 3, 76-9 (1968). (In Belorussian).

It was established that in all animals studied with the central nervous system (CNS) intact the free form of the amino acids predominated. In addition, it was found that in the cerebral hemispheres (CH), the bound amino acids were more abundant than in the cerebellum or the medulla. After general x irradiation at a dose of 40 R, it was established that in the gray matter of the CH there was an increased overall quantity of glutamate (GK) through 1 hr followed by a decrease toward the end of the 1, 7, 15, and 30th days. This reduction in GK content was indicated by the decrease in the quantity of free GK in all periods except the 7th day. In the white matter of the CH, the content of bound glutamate was decreased in all periods except the first day. For the cerebellum there was a characteristic increase in the free state of this amino acid except in the 7th and 30th days. In the medulla there was an

increased content of bound GK in all periods studied except the first hr. Following x irradiation there was an increase in the content of bound alanine (AL) in the gray matter of the CH except on the 7th day. In the white matter of the CH the bound AL is increased only through 1 and 24 hr, and free toward the end of the 1, 15, and 30th days. In the cerebellum the content of bound AL is increased after irradiation except during the first hour. In the medulla the content of bound AL is increased except on the 30th day. The concentration of aspartate (AK) is noticeably increased through 1 and 24 hr after x irradiation in the gray matter of the CH. In all subsequent periods a decrease in the content of AK was found at the expense of the free state of this amino acid. In the white matter of the CH there was an increase in AK only toward the end of the first hour and 30th day resulting from an increase in both bound and free forms. In the cerebellum the nature of the changes in the content of AK were the same as in the white matter. In the medulla, as in the cerebellum, the quantity of bound AK was increased in all periods except the 30th day. The content of free AK was reduced. (tr-auth)

7737 KINETICS OF UNSCHEDULED DNA SYNTHESIS INDUCED BY IONIZING RADIATION IN HUMAN LYMPHOCYTES. Spiegler, Peter. Los Angeles; Univ. of California (1968). 60p. Thesis.

A study of the rates of incorporation of ^{3}H-thymidine (^{3}HTdR) and ^{3}H-deoxycytidine (^{3}HCdR) into the DNA of human lymphocytes following exposure to ionizing radiation suggested the presence of two or more repair processes: one was rapid, essentially completed within 1 hr after irradiation; the other was slow and persisted for at least 7 hr after irradiation. The rate limiting step in the rapid process can be described by a simple enzyme model for which the substrates are ^{3}HTdR or ^{3}HCdR (or a metabolite whose concentration is proportional to the exogenous concentration of ^{3}HTdR or ^{3}HCdR) and the radiation induced lesions (or some product the concentration of which is proportional to dose). In terms of the model, the effect of anoxia is to decrease two fold the concentration of lesions. The action of phytohemagglutinin is to double the concentration of the enzyme(s) prior to the onset of normal DNA synthesis. The rate limiting step in the slow process can also be represented by a simple enzyme(s) model with radiation induced lesions (or some product the concentration of which is proportional to dose) as substrate. A preliminary experiment suggests that both processes are induced by the monofunctional alkylating agent methyl methane sulfonate. (Diss. Abstr.)

7738 RADIATION GLYCEMIA IN TUBER TISSUE IN SOLANUM TUBEROSUM. Fink, J. (Plant Breeding and Acclimatization Inst., Radzikow, Poland). Hodowla Rosl., Aklim. Nasien.; 1: 75-90(1967). (In Polish).

The ability of irradiated tuber tissue extracts from Solanum tuberosum to reduce glucose was measured. Seventeen variations in the ability of the extracts to reduce glucose were found within 5 min of the start of irradiation. The reaction reached its peak between day 0 (latent period) and day 4 after irradiation. At high doses (million rads), reduction capacities reached the same peak activity immediately after irradiation that was obtained after 24 hr at lower doses. Investigations on starch reduction showed that the increased reduction ability following irradiation was not a direct result of a radiochemical effect. The ability of the irradiated tuber tissue extracts to reduce sugars was detectable for long periods following irradiation, and was thus thought to be a remote biochemical consequence of irradiation. Presumably, the reaction is a link in a common response to high-energy irradiation. A similar reduction ability was found in muscle tissues following whole-body irradiation in which hyperglycemia of the blood was also a result of the irradiation. (E.R.B.)

7739 THE ABSENCE OF PHOTOREVERSIBLE PYRIMIDINE DIMERS IN THE RNA OF ULTRAVIOLET-IRRADIATED TOBACCO MOSAIC VIRUS. Carpenter, J. M.; Kleczkowski, A. (Rothamsted Experimental Station, Harpenden, Eng.). Virology; 39: 542-7(Nov 1969).

Pyrimidine dimers of cyclobutane type were found in the RNA of tobacco mosaic virus when uv-irradiated free (about 1.0 per photoreactivable lesion), but not in the RNA irradiated inside the virus. As the photoreactivable kind of lethal damage is known to occur only in the free RNA, the occurrence of this kind of damage coincides with the formation of the dimers. (auth)

7740 REJOINING OF X-RAY-INDUCED BREAKS IN THE DNA OF EHRLICH ASCITES-TUMOUR CELLS IN VITRO. Matsudaira, Hiromichi (National Cancer Centre Research Inst., Tokyo); Nakagawa, Chiyoko; Bannai, Shiro. Int. J. Radiat. Biol., 15: 575-81(1969).

In vitro tumor cells collected immediately after x irradiation of previousiy killed mice were incubated under different conditions of temperature, atmosphere, cell concentration, and incubation medium and then analyzed for rejoining of x-ray-induced breaks in the DNA. Sedimentation profiles of the DNA were used; data are presented in graphic form. A complete interpretation of the results is not presented; it was concluded that the subject needed further investigation. (C.O.)

7741 PHOTOCHEMICAL ALTERATIONS IN RIBONUCLEIC ACID ISOLATED FROM ULTRAVIOLET-IRRADIATED TOBACCO MOSAIC VIRUS. Tao, Mariano; Small, Gary D.; Gordon, Milton P. (Univ. of Washington, Seattle). Virology; 39: 534-41(Nov 1969).

Pyrimidine residues in tobacco mosaic virus RNA were labeled with tritium at the 5 position. Following exposure of the labeled virus to uv radiation within a biologically significant dose range, the RNA was extracted with phenol and digested with a mixture of enzymes. The photoproducts were isolated by paper and column chromatography. The results demonstrate the formation of uridine hydrate and at least two other photoproducts. On Bio-Gel P-2 chromatography, these photoproducts appear to be the approximate size of UpU. No significant amount of uv reversible pyrimidine dimers is formed. (auth)

7742 INFLUENCE OF GIBBERELLIN ON THE ACTIVITY OF ENZYMES IN IRRADIATED PLANTS. Kryukova, L. M.; Mukhambetzhanov, K. K. (Pushchino-on-Oka Inst. of Biological Physics, Moscow). Dokl. Akad. Nauk SSSR; 187: 1412-14(21 Aug 1969). (In Russian).

The influence of gibberellins on oxidation-reduction of enzymes and RNA in irradiated plants was studied. Enzyme activity was studied in young pea leaves irradiated with a 25 kp dose of γ radiation at 500 R/min and sprayed with gibberellin in a concentration of 25 mg/1000 ml. The catalase activity was determined by a gasometric method. The tabulated data indicated that gibberellins decreased radiation injuries to the plant. (R.V.J.)

7743 INDUCTION OF EUGLENA TRANSFER RNA'S BY LIGHT. Barnett, W. Edgar; Pennington, C. J. Jr.; Fairfield, S. A. (Oak Ridge National Lab., Tenn.). Proc. Nat. Acad. Sci. U. S.; 63: 1261-8(Aug 1969).

Exposure of dark-grown, wild-type Euglena gracilis to light induces the formation of at least three new chromatographic species of tRNA. Parallel studies with a bleached uv-radioinduced mutant (W_3BUL) of Euglena demonstrate that the induction of these new tRNA species is dependent upon the cell's ability to form chloroplasts and rule out the possibility that the new species arise from an effect of light on the tRNA's per se. (auth)

7744 RECOGNITION OF ALTERED DEOXYRIBONUCLEIC ACID IN RECOMBINATION. Helling, Robert B. (Univ. of Michigan, Ann Arbor). J. Bacteriol.; 100: 224-30(Oct 1969).

Kinetics of inactivation of transduction by phage P1bt which had been treated with ultraviolet light (uv) or nitrous acid (NA) was examined. With Escherichia coli B/r (radiation-resistant), low doses of uv increased transduction frequency, but the frequency was exponentially inactivated by higher doses. Little initial stimulus was observed in strain $_{-1}$ (radiation-sensitive). The final rate of decay was the same as in B/r. The initial stimulus of transduction in B/r was probably a consequence of increased recombination resulting from dark repair. It was estimated that another nucleotide within 1000 nucleotide pairs had to be damaged by uv to prevent a given nucleotide from successful transduction. The NA dose response was the same for the two strains. An initial stimulus of transduction was followed by exponential decline. The UV-repair enzymes missing in B_{s-1} were not required for repair of NA-induced damage to transducing or lytic phage DNA. Low recovery of new mutations in the transductants showed that mutagen-induced damage to tranducing DNA was excluded from recombinant chromosomes. The few recovered mutants may have resulted from normal error in recombination. (auth)

7745 SOME EFFECTS OF SERUM ON PERIPHERAL LEUKOCYTE COUNT AND MOUSE THYMUS AFTER EXPOSURE TO X RAY. Hodes, M. E.; Yip, Lily C.; Yu, Pao-lo (Indiana Univ. Medical Center, Indianapolis). Contract AT(11-1)-1391. Proc. Soc. Exp. Biol. Med.; 132: 771-5(Nov 1969).

The C57B1/6 and Swiss mice were exposed to 300 to 400 R of x irradiation. The peripheral leukocyte count, thymus weight, and the specific activity of thymus DNA polymerase all decreased whereas the specific activity of thymus RNA polymerase increased above the levels of the age controls. A single injection of sheep serum, but not saline or sheep albumin, given within 1 hr after radiation hastened the return toward normal values. The differences in enzyme activities of the C57B1/6 were apparent at about day 4, in thymus weight about day 7, and in leukocyte count at the end of the second week. The relation of these changes to the prevention of x-radioinduced leukemia is not yet apparent. (auth)

7746 DEOXYPYRIMIDINES OF A BLOOD CLOT AS AN INDEX OF RADIATION SICKNESS. Tereshchenko, O. Ya. (Inst. of Biophysics, Moscow). Radiobiologiya; 9: 629-30(Jul-Aug 1969). (In Russian).

Under the influence of irradiation, the total content of acid-soluble deoxypyrimidines in nucleated cells of a blood clot in rats and rabbits increases. In rats a significant increase is noted at doses of 50 to 800 R. The fraction of deoxypyrimidines determined in these animals includes deoxycytidine. (tr-auth)

7747 MECHANISM OF RADIATION INACTIVATION OF THE ABILITY OF DNA TO INHIBIT THE TRANSFORMATION OF BACILLUS SUBTILIS. Usakovskaya, T. S.; Stolyarova, L. G.; Tseitlin, P. I.; Pekhov, A. P. (Inst. of Experimental Biology, Moscow). Radiobiologiya; 9: 611-14(Jul-Aug 1969). (In Russian).

Within the investigated range of irradiation doses (10 to 100 kR), the drop in the ability of DNA to inhibit the transformation of Bacillus subtilis is associated chiefly with a disturbance of its primary structure. However, the possibility remains that when the irradiation doses are increased, the mechanism of the inhibition of transformation may be influenced by profound denaturation and degradation of DNA. (tr-auth)

7748 SOME IMPORTANT PECULIARITIES IN THE INFLUENCE OF IONIZING RADIATION ON THE PROPERTIES OF SUPERMOLECULAR DNP SYSTEMS. Andrianov, V. T.; Pisarevskii, A. N.; Spitkovskii, D. M.; Krot, V. I. (Belorussian State Univ., Minsk. Inst. of Experimental Biology, Moscow). Radiobiologiya; 9: 608-10(Jul-Aug 1969). (In Russian).

An investigation was made of the influence of ionizing radiation on condensed nucleoprotein (DNP) systems. It was shown for the first time that in this case there is a sharp shift of the curve of the dependence of the length of DNP fiber on the temperature in the direction of lower temperatures (by approximately 30°). This effect occurs only in the case of nonproteinized preparations of DNP and in the absence of divalent metal ions in solution. (tr-auth)

7749 COMBINED EFFECTS OF UV AND X RADIATION ON RIBONUCLEASE. Komolova, G. S.; Belikova, E. V.; Egorov, I. A. (Inst. of Biochemistry, Moscow). Radiobiologiya; 9: 614-17(Jul-Aug 1969). (In Russian).

Spectral investigations of solutions of RNAase, irradiated with uv and x rays, indicated identity in the mechanism of the action of the two factors. In the case of complex simultaneous or successive effects of x rays and uv radiation, a summation of the effects induced by each factor individually is observed. (tr-auth)

7750 CHANGE IN THE ACTIVITY OF CERTAIN ISOENZYMES OF THE RAT BLOOD SERUM AND LIVER DURING ACUTE RADIATION SICKNESS. Surinov, B. P.; Kashkin, K. P.; Bochkova, D. I. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya; 9: 522-30(Jul-Aug 1969). (In Russian).

The isoenzyme composition of alkaline phosphatase, lactate dehydrogenase, and aspartate aminotransferase in the blood serum and in various extracts of rat liver was studied. The phase changes both in the total activity and in individual isoenzymes of different organ and subcellular origin in the rat blood serum and liver were followed during the dynamics of acute radiation sickness. It was established that death of the animals both during early periods and at the height of radiation sickness occurred against a background of a substantial change in the ratio of the activities of various isoenzymes. (tr-auth)

7751 THE EFFECT OF IONIZING RADIATION ON SELECTED CHEMICAL, PHYSICAL, AND MICROBIOLOGICAL CHARACTERISTICS OF EGG WHITE PROTEINS. Mohamed, Shawky Yassin. College Station, Tex.; Texas A and M Univ. (1969). 83p.

Thesis.

The effect of gamma radiation on selected chemical, physical and microbiological characteristics of three egg white proteins have been studied. Lysozyme, ovalbumin and conalbumin substrates were extracted from egg albumen, purified and used in this study. Two strains of Pseudomonas fluorescens which had been isolated from milk and eggs were characterized and used for testing the microbiological growth support characteristics of the three proteins. Exposure of 0.5 percent lysozyme, 1.0 percent ovalbumin, or 1.0 percent conalbumin solution to 0.850 Mrad of gamma radiation did not produce a major change in density, viscosity or pH. Growth rates of P. fluorescens on irradiated protein substrates were lower than those on the non-irradiated control substrates. However, a reversal of the radiation induced damage to the growth support characteristics was noted during a three-week post-radiation frozen storage period. The four reactive sulfhydryl groups in ovalbumin were decreased to three by exposure to 0.850 Mrad of gamma radiation. A positive relationship between the number of reactive sulfhydryl groups and the growth of P. fluorescens on ovalbumin substrate was noted. Irradiation of 1.0 percent conalbumin solution with 0.850 of gamma radiation caused a slight increase in the iron-binding activity although freezing and thawing procedures effected a decrease of about 25 percent. However, during a three week post-radiation frozen storage period the iron-binding activity of both the radiated and radiation-controls increased. (Diss. Abstr.)

7752 INFLUENCE OF γ RADIATION ON THE ISOZYME COMPOSITION OF LACTIC DEHYDROGENASE IN THE FIRST DAYS OF DEVELOPMENT OF NEWBORN RATS. Kuzin, A. M.; Vygovskaya, G. P. (Moscow Technological Inst. of the Meat and Milk Industry). Radiobiologiya; 9: 531-5(Jul-Aug 1969). (In Russian).

The change in the isozyme composition of lactic dehydrogenase of the liver, skeletal muscles, and cardiac muscles was investigated on newborn rats for a period of 20 days of development after irradiation at a dose of 400 R. It was shown that under the influence of irradiation, the percent of isozymes rich in H is increased in the liver, while the content of M_4 is reduced. The H/M ratio is higher among irradiated animals than among the controls on all the investigated days of development. Analogous changes, but less pronounced, occur in the skeletal muscles as well. A lag in the increase in H subunits and a drop in the M content are observed in the cardiac muscles. As a result, H/M in the cardiac muscles is lower among the irradiated animals in comparison with the control. (tr-auth)

7753 FUNCTIONAL STATE OF THE BLOOD-CLOTTING SYSTEM DURING EXPERIMENTAL RADIATION SICKNESS IN ANIMALS. Kudryashov, B. A.; Pastorova, V. E.; Sytina, N. P.; Serebryakova, T. N. (Moscow State Univ.). Radiobiologiya; 9: 536-9(Jul-Aug 1969). (In Russian).

The irradiation of animals at a dose of 600 R induces a depression of the blood-clotting system on the eighth to tenth days after irradiation. Among animals irradiated at doses of 300 and 150 R, an activation of the blood-clotting system is observed on the eighth to tenth days of the experiment. In this case intravenous injection of tissue thromboplastin causes death of the experimental animals in considerably smaller numbers in comparison with the control group and with the animals irradiated at a dose of 600 R. (tr-auth)

7754 COMPARATIVE INVESTIGATION OF THE EFFECTS OF γ RAYS AND RADIOTOXINS ON THE INTRINSIC LUMINESCENCE OF EHRLICH'S ASCITES CARCINOMA CELLS. Khakimov, P. A.; Kondratenko, V. G. (Inst. of Biochemistry, Tashkent. Inst. of Biological Physics, Pushchino-on-Oka, USSR). Radiobiologiya; 9: 506-9(Jul-Aug 1969). (In Russian).

It was established by uv fluorescence microscopy that under the action of γ rays on Ehrlich's ascites carcinoma cells, an intensification of the uv luminescence of the cells is observed, that depends on the magnitude of the dose and the time after irradiation. It was shown that radiotoxins also produce an intensification of the uv luminescence of the cells that in turn depends upon the concentration of radiotoxins and the time of their influence. It is concluded that these two factors are apparently based upon a similar mechanism associated with a change in the protein component of the cell cytoplasm. (tr-auth)

7755 REPAIR REPLICATION OF DNA IN ULTRAVIOLET IRRADIATED MYCOPLASMA LAIDLAWII B. Smith, Douglas W.; Hanawalt, Philip C. (Stanford Univ., Calif.). J. Mol. Biol.; 46: 57-72(28 Nov 1969).

Cesium chloride density-gradient techniques were used to detect repair replication in the pleuropneumonia-like organism Mycoplasma laidlawii B following ultraviolet irradiation. Two methods of analysis were used, the first assaying repair in parental DNA shortly after uv irradiation, the second assaying repair in the parental DNA only after one round of semi-conservative replication. The second method assays repair only in DNA which has been rendered functional with respect to normal replication following the uv irradiation. For a dose of 85 ergs/mm^2, the kinetics of repair replication were linear to apparent saturation after about 0.5 generation and a replacement of 1.2% of the M. laidlawii B chromosome. A dose-response analysis showed that the amount of repair increased rapidly with dose at low uv doses (less than 5 ergs/mm^2), but then more slowly to an apparent saturation at about 100 ergs/mm^2. Both assay methods yielded essentially the same values, indicating no difference between the extent of repair replication ahead of and behind the normal replication growing point. Visible light illumination after ultraviolet light reduced the amount of repair

replication, as consistent with the existence of an enzymic mechanism for photoreactivation in this organism. The existence of repair replication in the mycoplasmas, possibly the simplest of free-living organisms, demonstrates the importance of repair mechanisms for the maintenance of genetic continuity in living systems. (auth)

7756 ABSORPTION OF GLUCOSE AND SACCHAROSE IN PATIENTS IRRADIATED IN THE ABDOMEN: DIRECT COMPARISON BETWEEN TWO TESTS. Giannardi, G.; De Marzi, S.; Renzi, R.; Atzeni, G. (Univ., Florence). Nunt. Radiol., 33: 1201-9(Oct. 1967). (In Italian).

Continuing the researches on the changes of intestinal absorption of carbohydrates during radiotherapy of the abdomen, the authors examined in a group of 22 patients the changes induced on the curves by oral load of glucose and saccharose. A significant lowering at the dose of 3000 and 5000 R for the saccharose was observed, whereas for the glucose, at the dose of 5000 R, the values rose slightly. Evaluation of the behavior of the curves by oral load of the two sugars in all the examined subjects points out that the damage of the intestinal absorption for the glucose already occurs at the dose of 3000 R and seems to confirm a greater involvement of the absorption of the saccharose. (auth)

7757 MOLECULAR PHOTOBIOLOGY. INACTIVATION AND RECOVERY. Smith, Kendric C.; Hanawalt, Philip C. An International Series of Monographs and Textbooks. New York; Academic Press, Inc. (1969). 246p. $10.00; 93s.

Interactions of light, with emphasis on the ultraviolet region of the spectrum, that cause damage to proteins and nucleic acids in living systems are considered in this book. The kinds of photochemical reactions that can occur and effects at the molecular, cellular, and organismal levels are discussed. Chapters are included on photoinactivation of biological systems, ultraviolet mutagenesis, and photodynamic action. Mechanisms by which cells can repair damaged genetic material and thus recover from inactivating effects of light are considered. Biological effects of ionizing radiation are compared and contrasted with those of ultraviolet radiation. The book is a valuable source of information for physicists, chemists, and biologists as well as an ideal text for senior and graduate students. A subject index and glossary are included. (H.L.W.)

7758 EFFECTS OF ULTRAVIOLET RADIATION ON INCORPORATION OF TRITIUM LABELED THYMIDINE INTO NUCLEI OF HeLa CELLS IN SYNCHRONIZED CULTURES. Firket, Henri (Univ., Liege). Compt. Rend., Ser. D; 269: 1230-1 (29 Sep 1969). (In French).

Synchronized cultures of HeLa cells were uv-irradiated either at the sixth hr, G_1, before the phase of divisions, or immediately afterwards in G_2. In both cases there was a marked increase in the number of cells actively incorporating the tritium-labeled thymidine during the hr immediately following irradiation. (tr-auth)

7759 ELECTROLYTE TRANSPORT AND VOLTAGE MEASUREMENTS WITH RAT INTESTINE IN VITRO. McKenney, Joel R.; Sullivan, M. F. (Battelle-Northwest, Richland, Wash.). Amer. J. Physiol.; 217: 1728-35(Dec 1969).

The ability of isolated rat intestine for salt and fluid transport was examined in relation to the contributions of passive electrolyte and water fluxes and the voltage difference across the intestine wall. The experimental procedure used allowed repeated flux and voltage measurements across everted segments of rat jejunum and ileum. Measurements were made at normal and reduced concentrations of Na^+ and Cl^-; and the effects of temperature, chronic bile diversion, and x radiation were determined. The results demonstrate that isolated ileum can absorb Cl^- in opposition to simultaneous opposing voltage and concentration differences. Isolated jejunum became capable of this function following prior chronic diversion of bile from the intestine. Glucose still induced relatively normal positive voltage differences across the intestine wall following prior x radiation exposure that depressed salt transport. In contrast, the ability of intestinal segments for salt transport was related to their ability to develop reversed voltage differences (serosal surface negative relative to mucosal surface) when the concentration of extracellular Na^+ was reduced. (auth)

7760 PRODUCTION OF FREE RADICALS IN REDUCED GLUTATHIONE AND PENICILLAMINE BY THERMAL HYDROGEN ATOMS AND X-RADIATION. Copeland, Edmund S. (Roswell Park Memorial Inst., Buffalo). Int. J. Radiat. Biol.; 16: 113-20(1969).

Electron-spin-resonance spectroscopy was used to observe the free radicals induced in reduced penicillamine and reduced glutathione both by x-irradiation at 77°K indicated that free radicals were initially located on α-carbon atoms in both molecules. When irradiated penicillamine was gradually warmed, E.S.R. centers were completely transferred to sulphur at about 200°K. In the case of irradiated glutathione, however, 8 days at room temperature were required for transfer of E.S.R. centers to sulphur. Hydrogen-atom bombardment resulted in the formation of the organo-sulphur radical in both compounds without evidence of hydrogen abstraction from α-carbon atoms. (auth) (UK)

Immunology

Refer also to abstracts 7968 and 8006.

7761 TRANSFER OF RESPONSIVENESS TO HAPTEN CONJUGATES OF POLY-L-LYSINE AND OF A COPOLYMER OF L-GLUTAMIC ACID AND L-LYSINE TO LETHALLY IRRADIATED NON RESPONDER GUINEA PIGS BY BONE MARROW OR LYMPH NODE AND SPLEEN CELLS FROM RESPONDER GUINEA PIGS. Foerster, John; Green, Ira; Lamelin, Jean-Pierre; Benacerraf, Baruj (National Inst. of Health, Bethesda, Md.). J. Exp. Med.; 130: 1107-22(1 Nov 1969).

Hartley guinea pigs genetically unresponsive to hapten-PLL (poly-L-lysine) conjugates were lethally irradiated and given allogeneic bone marrow from Hartley responder animals. Many of the animals died of graft versus host disease before their response to 2,4-dinitrophenyl-PLL (DNP-PLL) could be measured. The immune response of the surviving recipient animals was evaluated by anti-DNP antibody production, development of delayed hypersensitivity to DNP-poly-L-lysine, as well as by lymph node cell stimulation in vitro by this antigen. Twelve of 14 recipient animals thus treated made an immune response as measured by two of the three parameters. Strain 13 guinea pigs, genetically unable to respond immunologically to DNP-PLL and DNP-GL (2,4-dinitrophenyl-L-glutamic acid L-lysine copolymer) were lethally irradiated and given bone marrow from (2×13) F_1 responder animals or strain 13 bone marrow and (2×13) F_1 lymph node and spleen cells. A high proportion of the animals survived this procedure; no evidence of graft versus host disease was observed. Three of three strain 13 animals irradiated and, given strain 13 bone marrow and (2×13) F_1 lymph node and spleen, and then immunized with DNP-PLL, made a specific immune response. Seven of 10 irradiated strain 13 animals given strain 13 bone marrow and (2×13) F_1 lymph node and spleen made an immune response to DNP-GL. However, only one of six irradiated strain 13 animals made a vigorous immune response to DNP-GL after reconstitution with (2×13) F_1 bone marrow alone. The ability to transfer the immune response to PLL antigens from responder to nonresponder animals demonstrates unequivocally that the defect in the nonresponder animals is immunological rather than due to some other type of nonimmunological mechanism. The bone marrow contains all the immunological cells necessary for the expression of the PLL gene. However, the finding that (2×13) F_1 lymph node and spleen cells were more effective than (2×13) F_1 bone marrow cell populations (known to be a rich source of monocyte precursors) suggests that the cells in which the PLL gene function is expressed may be lymphocytes rather than monocytes and macrophages. (auth)

7762 EVIDENCE FOR A SMALL POOL OF IMMUNOCOMPETENT CELLS IN THE MOUSE THYMUS. Blomgren, H.; Andersson, B. (Karolinska Institutet Medical School, Stockholm). Exp. Cell Res.; 57: 185-92(Oct 1969).

The graft-versus-host reactivity of thymus cells from normal mice was compared with the reactivity of thymus cells from mice previously injected with cortisone or x-irradiated with 400 R. The reactivity of the cortisone-resistant cells was ten times higher than the reactivity of normal thymus cells, whereas x irradiation did not increase the relative reactivity of the thymus cells. The cortisone-resistant cells, that were known to be located in the thymus medulla, had the same volume distribution as normal lymph node lymphocytes. (auth)

7763 IMMUNOLOGIC COMPETENCE OF BONE MARROW OF DIFFERENT GENOTYPES. Uphoff, Delta E. (National Cancer Inst., Bethesda, Md.). J. Nat. Cancer Inst., 43: 1055-66(Nov 1969).

Marrow cells of different genotypes of inbred mice differ in their immunologic reactivity. This was indicated by the variability in survival patterns of lethally x-irradiated recipients of marrow from presensitized donors of different strains. A graft-versus-host reaction was induced when the presensitized donors and recipients were of the same H-2 genotype. The severity of a mild spontaneous reaction was increased by prior sensitization of the donor. The most severe spontaneous graft-versus-host reaction occurred when donor and recipient were of different H-2 genotypes. Pretreatment of these donors did not alter the survival pattern. The protective capacity of marrow of some

genotypes was modified after contact with tissue antigens of the recipient. This modification resulted in an early mortality during the first week post irradiation that was not considered to be an accelerated graft-versus-host reaction primarily because it occurred in only a few combinations of strains and was not characteristic of strain combinations with the greatest antigenic disparity. The time of onset of the spontaneous and the induced graft-versus-host reaction indicated that the marrow cell suspension contained a primary stem cell that completely repopulated the entire hematopoietic system. (auth)

7764 DENSITY DISTRIBUTION ANALYSIS OF ANTIGEN-SENSITIVE CELLS IN THE RAT. Haskill, J. Stephen (Walter and Eliza Hall Inst. of Medical Research, Melbourne). J. Exp. Med., 130: 877-93(Oct. 1, 1969).

Analysis of the cell populations capable of initiating a response to sheep and horse erythrocyte antigens was carried out by means of equilibrium density gradient centrifugation. The results indicate that there are at least six distinguishable antigen-sensitive (AS) cell populations for sheep erythrocytes, but only three for horse erythrocytes in the spleen of the Lewis rat. Evidence is presented for the existence of metabolic, physiological, and immunological differences among these populations. It is suggested that at least one population of AS cells responds only to the specific antigen, and at least one other population is sensitive to stimulation by a broad range of antigens. It is assumed that the difference between these two AS cells results from a process of differentiation of AS cells primed into DNA synthesis by antigen stimulation. (auth)

7765 ROENTGEN-IRRADIATED BONE CHIP AS TRANSPLANT. ANIMAL EXPERIMENTAL STUDY. Noeh, E. Beitr. Orthop. Traumatol., 14: 566-7(Oct. 1967). (In German).

From the scapula of rabbits, bone chips were taken and exposed to x radiation doses from one to two MR. Following irradiation, the chips were reimplanted into their original location. Bone exposed to less than 1.5 MR was accepted without any tissue reaction. Higher doses lead to striking callus formation. (H.B.G.)

7766 INTERFERON SYNTHESIS IN X-IRRADIATED ANIMALS. IV. DONOR-TYPE SERUM INTERFERONS IN RAT-TO-MOUSE RADIATION CHIMERAS INJECTED WITH NEWCASTLE DISEASE VIRUS. De Maeyer-Guignard, Jaqueline; De Maeyer, Edward; Jullien, Pierre (Institut du Radium, Biologie, Orsay, France). Proc. Nat. Acad. Sci. U. S., 63: 732-9(July 1969).

C_3H/He mice were exposed to whole-body x irradiation of 1000 R and received thereafter 10^7 xenogeneic Wistar rat marrow cells intravenously. In these rat-to-mouse chimeras, serum interferon-producing capacity upon injection of Newcastle disease virus was examined four weeks after grafting. Normal levels of circulating interferon were produced. The interferon, however, had the species specificity of rat interferon, being 20 times more active in rat embryo fibroblasts than in mice embryo fibroblasts. Moreover, it behaved like rat interferon when filtered on Sephadex G-100 dextran gel, displaying one peak of activity in the 90,000 molecular-weight and two incompletely separated peaks of 32,000 and 24,000, respectively, in the 30,000 molecular-weight region. The fact that the interferon is of the donor type in rat-to-mouse chimeras permits us to conclude that circulating interferon induced by Newcastle disease virus is made in bone-marrow-derived cells. (auth)

7767 SOME PECULIARITIES OF THE IMMUNOBIOLOGICAL REACTIVITY OF DOGS IN THE LONG-TERM PERIODS AFTER THE INFLUENCE OF IONIZING RADIATION. Mal'tsev, V. N.; Evseeva, N. K. (Inst. of Biophysics, Moscow). Radiobiologiya; 9: 623-5(Jul-Aug 1969). (In Russian).

The state of the bactericidal function of the skin with respect to foreign microbes (intestinal bacillus), the skin microflora, the phagocytic activity of the neutrophils, and the ability of the organism to manufacture antibodies was studied in experiments on 23 mongrel dogs. Examinations were made 3 months, 1, 2, 3, and 4 yrs after irradiation. It was established that the restoration of the intensity of natural immunity is unstable and gives way to an inhibition of it. (tr-auth)

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Refer also to abstracts 7416, 7702, 7707, 7711, 7714–7717, 7719, 7721, 7727, 7814, 7815, 7821–7826, 7828–7830, 7832, 7841, 7843–7849, 7858, 7860, 7869, 7872–7874, 7876–7880, 7886, 7887, 7912–7919, and 8008.

7768 (RISO-203) ENVIRONMENTAL RADIOACTIVITY IN GREENLAND IN 1968. Aarkrog, A.; Lippert, J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jul 1969. 18p. Dep. CFSTI (U. S. Sales Only).

Measurements of fallout radioactivity in Greenland in 1968 are reported. Strontium-90 (and ^{137}Cs in most instances) was determined in samples of precipitation, sea water, vegetation, animals, and drinking water. Estimates of the mean contents of ^{90}Sr and ^{137}Cs in the human diet in Greenland in 1968 are given. (auth)

7769 (STI-PUB-226) ENVIRONMENTAL CONTAMINATION BY RADIOACTIVE MATERIALS. Proceedings Series. Proceedings of a Seminar Held at Vienna, 24–28 March 1969. (International Atomic Energy Agency, Vienna (Austria)). Sep 1969. 758p. (In several languages). (CONF-690317). IAEA: $20.00.

Separate abstracts were prepared for 57 papers presented at the conference. Refer to Conference 690317 in the report number index for reference to an additional five papers presented on various aspects of environmental contamination. (H.L.W.)

For abstracts of individual papers see: 7416, 7707, 7720, 7721, 7781–7795, 7821–7830, 7841–7850, 7872–7880, 7912–7919, and 7921.

7770 (TID-3917) MARINE RADIOECOLOGY. A Selected Bibliography of Non-Russian Literature. Edmundson, Eldon Jr.; Schultz, Vincent (Washington State Univ., Pullman. Dept. of Zoology); Klement, Alfred W. Jr. (Nevada Operations Office (AEC), Las Vegas). Oct. 1969. 127p. Dep. CFSTI.

A bibliography is presented containing 1450 reference citations to the non-Russian literature on marine radioecology. Reports of laboratory and field studies are included as were those of salt and brackish water and anadromous and catadromous species. Studies of the sources of radionuclides in marine environments are also included. The citations are listed in alphabetical order according to the last name of the author. (E.R.B.)

7771 MAN-MADE ^{14}C IN DEEP PACIFIC WATERS: TRANSPORT BY BIOLOGICAL SKELETAL MATERIAL. Somayajulu, B. L. K. (Scripps Institution of Oceanography, La Jolla, Calif. Tata Inst. of Fundamental Research, Bombay); Lal, D.; Kusumgar, S. Science; 166: 1397-9(12 Dec 1969).

Calcareous particles present in Pacific waters at depths of 50 to 3500 meters were collected by filtering seawater through spongin matrix. The specific activity of carbon-14 could be measured in two of these collections from depths of 2300 and 3500 meters. The ratios of carbon-14 to carbon-12 correspond to values observed in surface waters in recent years as a result of the addition of man-made carbon-14, thus indicating that the calcareous particles resulted from recent biological productivity. The results are related to the mean settling rates and the sizes and dissolution rates of biogenic calcareous particles in transit through a seawater column. (auth)

7772 BEHAVIOR OF ^{144}Ce IN VARIOUS TYPES OF SOIL. Molchanova, I. V. Tr. Inst. Ekol. Rast. Zhivotn.; No. 61, 4-11(1968). (In Russian).

Microquantities of ^{144}Ce in solution at acid pH values were completely absorbed by the types of soils that were studied. In the range of neutral and alkaline pH values, the absorption of cerium by soils was decreased. The type of soil also had an effect on the stability of cerium binding in the soil. The cerium was bound most securely in turf-meadow soil and black soil (cernozyom). Absorbed cerium was more easily removed from all soils by the salts of iron then by salts of aluminium and copper. The presence of colloids of iron in the solution decreased the absorption of cerium by soils in the range of pH values studied. The percent sorption of ^{144}Ce by soils decreased more sharply as a result of the presence of iron colloids than the concentration of iron in the solution. Aqueous extracts from the leaves of ligneous plants increased the mobility of cerium in the soil-solution system for all of the types of soils studied. (tr-auth)

7773 INFLUENCE OF AQUEOUS EXTRACTION FROM TREE LEAVES ON THE MIGRATION OF ^{54}Mn IN VARIOUS TYPES OF SOILS. Chebotina, M. Ya. Tr. Inst. Ekol. Rast. Zhivotn.; No. 61, 26-30(1968). (In Russian).

Aqueous extracts from the leaves of ligneous species, in comparison with water, increased the migration capability of ^{54}Mn in a solution–soil system. However, their influence was not as great as the desorbing action of a 0.01 M solution of EDTA. The mobility of manganese under the influence of the extracts depended on the type of soil and was increased in a series: turf-meadow soil — black soil — red soil — turf-podzolic, horizon A_2. According to the extent of desorbing capability, the extracts were arranged: pine — birch — linden tree — cherry — aspen. (tr-auth)

7774 INFLUENCE OF CERTAIN COMPLEXONS ON RADIOISOTOPE SORPTION BY SOIL. Kulikov, N. V. Tr. Inst. Ekol. Rast. Zhivotn.; No. 61, 21-5(1968). (In Russian).

The greatest efficiency for reducing the sorption by the soil of radioisotopes of cobalt, zinc, cadmium, cerium, and ruthenium was obtained with EDTA and DTPA, and calcium and strontium—EDBIP and DTPA. All of the chelates were ineffective for the radioisotopes of rubidium, silvers, and cesium. EDTA and DTPA are of interest for further study under growing conditions and also in field experiments with the purpose of increasing the migration capability of cobalt, zinc, cadmium, cerium, and ruthenium isotopes in more complex soil-solution-plant. (tr-auth)

7775 INFLUENCE OF SOIL MOISTURE ON THE BEHAVIOR OF ^{35}S, ^{60}Co, AND ^{90}Sr IN THE SOIL-PLANT SYSTEM. Mironov, B. A.; Karavaeva, E. N. Tr. Inst. Ekol. Rast. Zhivotn.; No. 61, 35-46(1968). (In Russian).

Experiments on the concentration of three radioisotopes in plants showed that ^{35}S was heavily concentrated, ^{90}Sr was concentrated one or two orders of magnitude less, and ^{60}Co three orders of magnitude less. At low soil moistures, ^{35}S concentrations were decreased in pea plants by one order of magnitude and by two orders in barley plants in comparison with concentrations at high soil moisture values. Strontium-90 was concentrated most intensively in plants at high soil moisture values and slightly less at low and average values. The highest concentration of ^{60}Co in pea plants was observed at low soil moisture values, and in barley plants at high values. The concentration of ^{90}Sr and ^{60}Co in pea plants varied to considerable extent under different experimental conditions. Variations were not as great in barley plants. The concentration of ^{35}S differed less significantly with changes in experimental conditions. The distribution of ^{60}Co in the organs of pea and barley plants at all levels of soil moisture was acropetal. The distribution of ^{90}Sr in the organs of pea plants at high soil moistures was basipetal, while at low levels it was acropetal. Changes in the soil moisture altered the distribution of ^{35}S concentrations in the organs of pea plants, but in the opposite direction. The general accumulation of radioisotopes by vegetation in all aspects of the experiment was decreased with the decrease of soil moisture. For ^{60}Co, it was 0.10% of the quantity introduced for ^{90}Sr—0.1%, and for ^{35}S—0.12%. Changes in soil moisture had an insignificant effect on the migration of ^{90}Sr, yet a reduction of moisture slightly increased migration. The influence of vegetation was significant, especially in regards to increased ^{90}Sr migration in soils at high and average moisture levels. Cobalt-60 migration was analogous, but the intensity of migration was less and vegetation only slightly increased it at low soil moistures. The influence of soil moisture on ^{35}S migration was significant, yet reductions in moisture led to reductions in migration. Vegetation promoted significantly the migration of ^{35}S in soil at high and average moisture levels and reduced it at low levels. (tr-auth)

7776 EFFECTS OF THE VEGETABLE COVER ON THE VERTICAL MIGRATION OF ^{144}Ce IN THE SOIL. Kulikov, N. V.; Korobitsyn, N. M. Tr. Inst. Ekol. Rast. Zhivotn.; No. 61, 47-54(1968). (In Russian).

The effect of perennial alfalfa on the vertical migration of ^{144}Ce in soil was studied. Upon addition in the superficial layer of soil (0 to 2 cm) for 14 months, including two summer seasons, cerium penetrated soil without a plant cover to a depth of 10 cm and in soil with plants to a depth of 30 cm. In this and other cases, most of the cerium (86 to 88%) remained in the area of application. The transport of cerium by the above ground parts of plants for two growing seasons represented 0.01% of the amount introduced into the soil. The plant roots accumulated approximately the same amounts. The coefficient of the accumulation of cerium for the above ground parts of alfalfa was 0.004 to 0.005 and for the roots in the area of soil where the cerium was introduced it was 0.04. In the above ground parts of alfalfa, cerium was accumulated mainly in the leaves, while in the root system it was accumulated in the areas that were in immediate contact with the radioisotope contaminated soil. The degree of fixing of ^{144}Ce in the soil did not depend on the time of its contact with soil particles. In soil on which plants were growing, an increase in the desorption of cerium by the cations of potassium, sodium, and calcium was noted. (tr-auth)

7777 UPTAKE OF ISOTOPES BY DEAD TISSUES OF FRESH-WATER PLANTS. Lyubimova, S. A.; Timofeeva, N. A.; Kulikov, N. V. Tr. Inst. Ekol. Rast. Zhivotn.; No. 61, 79-82 (1968). (In Russian).

To the problem of the absorption of radioisotopes by freshwater plants and their role in the processes of migration and distribution of emitters in the components of a reservoir, is added the almost complete lack of data concerning the fate of radioisotopes after the death of the plants and during the formation of detritus. In the present investigation, two examples of higher aquatic plants—bryophyta (Drepanocladus sendtneri) and hornworts (Ceratophyllum demersum) were studied. The accumulation of four major fission radioisotopes (^{90}Sr, ^{106}Ru, ^{137}Cs, and ^{144}Ce by living and dead tissues of freshwater plants, and the extraction of these radioisotopes from living and dead plants back into the environment and repeated accumulation by the living plants were studied. The data indicate that the coefficients of accumulation of ^{90}Sr for living and dead plants were approximately equal. The coefficients of accumulation of ^{137}Cs by living and dead hornworts did not differ essentially from each other, but for the bryophyta, the values for living plants were slightly higher than those for the dead tissues. The data, however, for ^{106}Ru and ^{144}Ce show that these radioisotopes are accumulated to a greater degree by the dead organic residues than by the living plants. The process of accumulation of the different emitters differed in time. For strontium, equilibrium in the water–biomass system (living and dead) was obtained during the first two days. For cesium and cerium, the coefficients of accumulation increased up to 16 days both for living plants and the dead organic residues. Data concerning the accumulation by the plants of emitters that were received in the water from living and dead vegetable tissues are also presented. The coefficients of accumulation for ^{90}Sr under all experimental conditions noticeably exceed those for ^{137}Cs. However, the values for each radioisotope were very close in experiments with the addition of emitters to water in the form of chlorides and in the form of the radioactive extracts from the biomass of living and dead plants. It is believed that ^{106}Ru and ^{144}Ce, due to the stability of their bonding in the disappearing biomass of plants, will be retained in the bottom deposits and thus be excluded for a certain time from the biological rotation of substances in the reservoir. The radioisotopes of strontium and cesium, on the contrary, are retained in solution and continue to be included in the cycles of biological rotation. (E.R.B.)

7778 ROLE OF FRESH-WATER PLANTS ON UPTAKE AND DISTRIBUTION OF ^{90}Sr IN WATER-BASIN COMPONENTS. Timofeeva, N. A.; Kulikov, N. V. Tr. Inst. Ekol. Rast. Zhivotn.; No. 61, 65-71(1968). (In Russian).

In spite of the relatively low (in comparison with other radioisotopes) coefficient of accumulation, the accumulation of ^{90}Sr was studied in 32 species of freshwater plants. Some species (Cladophora fracta, C. glomerata, and Potamogeton compressus) were capable of accumulating it in significant quantities (coefficients of accumulation from 1000 to 2000). The coefficients of accumulation for ^{90}Sr in living plants were related to the content of stable strontium, calcium, and magnesium in the water, but within broad limits did not depend on the specific radioactivity of the water. In the water-basin, the gravimetric ratio of the masses of water, soil, and plants was 85.0, 14.9, and 0.1% respectively. A significant part of the ^{90}Sr (about 58% of the total amount in the water-basin) remained in the water, 17% acted in the soil, and about 25% was accumulated by the plants. An increase in the content of calcium in the water decreased markedly the accumulation of ^{90}Sr by the soil and by the biomass of plants whereas it increased the ^{90}Sr content of the water. The discrimination between ^{90}Sr and calcium following their accumulation by the plants did not depend on the content of calcium in the water, but was determined to a significant degree by the individual peculiarities of the plants. The discrimination of ^{90}Sr following the formation of carbonate compounds by the plants did not depend on either the specific composition of the plants or the content of calcium in the water. The data on the kinetics of accumulation of ^{90}Sr by plants in relation to the content of stable strontium, calcium, and magnesium in the water and also the results of experiments on the separation of ^{90}Sr by plants suggest two possible processes that determine the capability of freshwater plants to accumulate this radioisotope: the one process—reversible, proceeding as a type of ionic exchange; the other—irreversible, proceeding at the expense of the coprecipitation of ^{90}Sr with calcium carbonates that are formed by the plant activity. As a result of carbonate formation, ^{90}Sr and calcium are partially excluded for a time from biological rotation in the water-basin. (tr-auth)

7779 ON THE PROPERTIES OF DESORPTIVE EFFECTS OF EXTRACTS ON LEAF FALL. Chebotina, M. Ya. Tr. Inst. Ekol. Rast. Zhivotn.; No. 61, 12-21(1968). (In Russian).

The desorbing action of extracts from the leaves of ligneous plants can be attributed to the content of organic substances (iron, cobalt) and cations capable of leaching microelements from the soil (strontium, cobalt). In the extracts studied, cobalt and manganese were mainly in true solution, yttrium however, was usually connected to colloids. The influence of low-molecular weight organic acids and amino acids on the mobility of the microelements can be compared with the influence of secondary vegetable products—humic and fulvic acid. (tr-auth)

7780 DAMAGE CAUSED BY NUCLEAR ACCIDENTS. Mitschrich, H. (Akademie des Sanitaets- und Gesundheitswesens, Munich). Muenchen Med. Wochenschr.; 111: 378-81(14 Feb 1969). (In German).

From 1945 to 1961, 160 accidents occurred in connection with

nuclear installations and/or devices producing high energy. Of these, eight accidents were of severe nature and 38 persons have been involved. The fate of the persons involved is, in addition to mechanical injuries, especially determined by the radiation dose they received. The hazard of an environmental contamination by radionuclides exists especially immediately after the accident by radioiodine and later by radioactive strontium and cesium. Rescue and protective measures have to be determined by radioactive readings and from a medical point of view. Three danger zones of radiation, surrounding the site of the accident, are marked out according to readings taken from radiac meters. Necessarily surgical procedures are to be performed as early as possible and prior to the onset of the main phase of radiation sickness with hemorrhages and infection. (auth)

7781 INSTALLATION OF A DEVICE FOR STUDYING MARINE POLLUTION (SEA-WATER, SEDIMENTS, MARINE ORGANISMS) IN BELGIUM. Peeters, Elisabeth (Institut Royal des Sciences Naturelles de Belgique, Brussels). pp 503-19 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969). (In French).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The Institut Royal des Sciences Naturelles de Belgique is currently developing in its Laboratory of Physical Oceanography a neutron activation analysis device for the study of the contamination by trace elements in seawater, sediments, and marine organisms. The Institute is also studying the pollution caused by atomic wastes, fallout and industrial radioactive contamination. This work is being carried out from the point of view of the European communities and of EURATOM, which are trying to carry out rapidly a concerted study of marine pollution due to various factors. The methods of sampling (some of them new) and of processing and analyzing the samples are described. Initial investigations indicated the need to make a parallel study of material in suspension (having a diameter less than 0.5 μm) and of the waters and sediments of the Scheldt estuary and off the Belgian coast. It became immediately obvious that, qualitatively and quantitatively, radionuclides are not distributed uniformly either in the material in suspension or in the sediments. The initial results indicate the presence of ^{40}K, of fission products (^{137}Cs, ^{95}Zr, ^{95}Nb, ^{144}Ce, ^{144}Pr, ^{147}Nd, ^{106}Ru, ^{106}Rh, and ^{103}Ru), and of daughter products of the uranium family (^{238}U, ^{226}Ra, ^{214}Pb, ^{214}Bi, and ^{210}Pb) and of the actinium family (^{211}Pb, ^{131}Ba, ^{231}Pa, ^{228}Th, ^{228}Ac, and ^{208}Tl). A thorough, systematic study will make it possible to distinguish between radioactive contamination of natural atmospheric or geological origin and radioactive contamination caused by nuclear facilities. (auth)

7782 TRITIUM UPTAKE FOLLOWING A THERMONUCLEAR TEST. Mason, B. J.; Wipper, W. J.; Leavitt, V. D. (Public Health Service, Las Vegas, Nev.). pp 167-74 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The mission of the Agrology Section of the US Public Health Service's Southwestern Radiological Health Laboratory is to develop radiation dose prediction models for components of man's food web that are likely to be affected by radioactivity resulting from the peaceful uses of nuclear explosives. At the Nevada Test Site this section has developed a farming facility which is located approximately two miles downwind from the nuclear crater resulting from the July 1962 detonation of the 100 kiloton thermonuclear device, Project Sedan. This report presents results of a study to evaluate the uptake of tritium by selected crops that are important to Nevada's agricultural economy. To determine the distribution of tritium from this detonation, a four-station transect was located along the axis from the Sedan crater to the farm facility. A graph of the 1968 tritium profile in the soil indicates a maximum concentration at a depth of approximately 70 cm. This depth is closely correlated with the depth of the maximum desert rainfall penetration for this area. Prior to cultivation, the tritium concentration in the soil surface plow layer of the farm ranged from 11.4 to 26.5 pCi/ml of soil water or 0.21 to 0.42 pCi/g of dry soil. Comparisons made between radishes (Raphanus sativus), potatoes (Solanum tuberosum), sweet corn (Zea mays), bush beans (Phaseolus vulgaris), watermelons (Citrullus vulgaris), and onions (Allium cepa) grown on the Nevada Test Site farm and similar produce purchased in the local markets indicated a significant difference between the tritium concentrations at the 99½% confidence level. Many of the items purchased in the local markets were below the minimum sensitivity of the analytical system used in this study. The levels in the Nevada Test Site crops ranged from 2.0 to 3.0 pCi/g of dry tissue, or 3.00 to 4.87 pCi/m of tissue water. Although the concentrations found are of little significance as far as total dose to humans is concerned, this study has indicated that tritium is available over considerable periods of time and does not leave the environment via evaporation as has been suggested. (auth)

7783 MECHANISMS OF TRANSFER OF RADIONUCLIDES TO MAN IN THE VICINITY OF A NUCLEAR FACILITY. Honstead, J. F. (Battelle-Northwest, Richland, Wash.). pp 381-91 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The Hanford plant in southeastern Washington, USA, provides an interesting opportunity to study the movement of radionuclides through food chains to man. For more than 20 yr this facility has discharged small concentrations of short-lived radionuclides to the Columbia River. It is possible to trace several radionuclides through a variety of environmental pathways originating with water from the Columbia River or from airborne radionuclides. The installation's environmental monitoring program samples and analyzes foodstuffs produced locally that might contain radionuclides originating in the Hanford plant. Whole-body counters operated by radiation protection services of the nuclear plant are routinely able to detect small body burdens of Hanford radionuclides in local residents. During the 10 years that the whole-body counter has been operating, more than thirteen thousand whole-body counts have been made. For most of these, a diet questionnaire was obtained that provided information concerning the individual's consumption of various foodstuffs of interest. These data are entered together in an electronic computer file for analysis and study. This paper discusses the dietary and whole-body counting data obtained from a sizable sample of people living in the vicinity of a nuclear facility and shows the correlations that permit determination of prominent pathways. A regression analysis may be used to quantitatively evaluate the relative significance of the various pathways. Whole-body counting data obtained during times of concentration changes in the environment permit large-population evaluation of uptake and retention parameters. Relations between whole-body counting results and foodstuff analyses are shown and examples are given of some of the computations made with sorted population groups drawn from the computer file. (auth)

7784 ^{131}I IN GRASS AND MILK CORRELATED WITH RELEASES FROM THE STUDSVIK RESEARCH STATION. Bergstroem, S. O. W.; Gyllander, Christina (Aktiebolaget Atomenergi, Studsvik, Sweden). pp 403-16 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

During late summer 1967, ^{131}I was released, mainly, from the Isotope Service at the Studsvik Research Station. The releases were caused by faulty filters in the processing equipment. Estimates of the actual releases and of the distribution between different chemical forms of iodine were made. As soon as the releases were discovered, a special survey was started to establish the relations between air, grass, and milk contamination. The survey included three nearby (0.5 to 1 km radius) farms with grazing cows. The results are compared with earlier observations on fallout from weapons testing. (auth)

7785 RELIABILITY OF ANALYTICAL DATA USED FOR ASSESSING THE DEGREE OF ENVIRONMENTAL CONTAMINATION BY RADIOACTIVE MATERIAL. Merten, D. (International Atomic Energy Agency, Vienna); Wortley, G. pp 477-85 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The present-day situation is discussed with regard to the reliability of analysis of biological materials for radionuclide content, which contamination results from the dispersal of radioactive materials into man's environment. Inter-laboratory comparisons on analysis of a number of radionuclides in the biological materials of particular significance to public health and agricultural interests are described. Factors that contribute to the unreliability found in some instances are discussed and means by which the situation could be improved overall are put forward. (auth)

7786 UPTAKE OF RADIOACTIVE NUCLIDES BY AQUATIC ORGANISMS: THE APPLICATION OF THE EXPONENTIAL MODEL. Hiyama, Y.; Shimizu, M. (Tokyo Univ.). pp 463-76

of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

A number of experimental works were carried out in connection with the uptake and loss of radionuclides by aquatic organisms. Theoretical considerations, however, were scarce and the fitting of theoretical curves to the observed values was not intensively done. Therefore, based on the exponential model, theoretical formulae that are considered to be appropriate for explaining the uptake and loss of radionuclides by aquatic organisms were derived and applied to the experimental data. A compartment model was adopted. Experiments were also carried out under these conditions and the theoretical curves were applied to the observed values obtained under each condition. Radioisotopes of Cs, Sr, Zn, Cd, Ce, I, and Co were used in the experiments and for almost all of the cases the theoretical curves could be fitted and the model adopted proved to be useful. In addition, it became clear that concentration factors under conditions of changing radioactivity in the environmental water may not remain constant, suggesting a need to be careful when using concentration factors obtained under these conditions. (auth)

7787 FIELD MONITORING AND INVESTIGATIONS FOR THE EVALUATION OF PUBLIC HEALTH HAZARDS THROUGH CONTAMINATION OF WATER SOURCES. Kamath, P. R.; Bhat, I. S. (Bhabha Atomic Research Centre, Bombay). pp 435-47 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Soil-plant relations have been reported extensively from laboratory and field studies that have given some insight into the plant uptake mechanisms. Fallout deposition on soil and foliage was employed to study the contributions in the plant uptake through foliar absorption and from soil through roots. Farm investigations were carried out to obtain understanding and guidance for the monitoring of land produce from observed selective and preferential uptakes of radionuclides and trace elements in certain kinds of vegetation over others. Field studies were carried out to determine mineral uptake in a wide variety of popularly used vegetables and fruit grown on the laboratory farm at Tarapur under controlled conditions. Results showed that in most non-leafy vegetables and cereals, the fallout content invariably related to mineral uptake from soils in spite of high surface contamination. Banana leaves, for example, were found to be good collectors of fallout, while the banana flesh is probably the least contaminated. The Tarapur region comes under the influence of heavy monsoon rains, which is generally the period of intense agricultural activity; most farming in other seasons is done with water from wells and hold-up reservoirs. Monsoon brings down 90 to 95% of the total annual fallout. The flushing effect of the downpour was studied by exposing soil blocks in situ and collecting the seepage during the three-months duration of monsoon rains. Of the 82 pCi of ^{90}Sr and 93 pCi of ^{137}Cs present in the total rains only about 5% appeared in the effluents. Fresh fallout contaminations were also utilized to study uptake in farm produce, grass, farm animals, and milk. The possible retention of released activity in salt produced by solar evaporation was studied in the laboratory with seawater spiked with fission and induced radionuclides. Sea-salt experiments for example showed little ^{137}Cs even in crude salt, while considerable ^{90}Sr was retained. These studies indicated the priorities in land monitoring programs that may be usefully adopted at a site where contamination of surface and groundwater is likely from nuclear operations. (auth)

7788 MORPHOLOGICAL, PHYSIOLOGICAL, AND ENVIRONMENTAL CONDITIONS AFFECTING THE ACCUMULATION OF LONG-LIVED RADIONUCLIDES FROM FISSION PRODUCTS BY PLANTS. Keppel, H. (Research Center for Agriculture, Brunswick). pp 99-111 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

In the food chain from the seed, through food-processing factories or fodder for animals to human food the growing stage is the most liable to contamination by airborne radionuclides. This contamination of the growing plant is the main source of incorporation of radioactive material by animals and humans. The danger of total or external contamination of plants is enhanced, in contrast to that of animals or men, on the one hand by deposition in a fixed place and on the other by the non-specific uptake of mineral nutrients. The difference in the habits of plant species, in their physiological states and in the environmental conditions in which they grow, affects the extent of the contamination. Among the factors which influence the accumulation of radionuclides by plants is the morphological constitution of the leaves and the structure of the roots. These factors are not only capable of reinforcing each other but also of acting to some extent in opposite directions. Extended foliage is not always accompanied by a high rate of uptake. On the other hand, a small but finely divided root system lying immediately under the surface may lead to higher contamination than a strong and deep reaching one. The rate of the uptake proper is a function of the physiological state of the plant, and here one must differentiate between the processes of diffusion and active transport. The growth of the plant regulates the requirement of minerals, and the incorporation therefore changes within the vegetation period. Finally, the site in which the plant grows affects the accumulation of the radionuclides. This factor includes not only the climatic conditions but also the nature of the soil. Rain causes a leaching of the mineral substances which adhere to the surface of the leaves and originate in fallout or in secretion of the transpiration flow. In a soil rich in clay minerals and therefore of a high ion-exchange capacity the elements are more fixed than in a sandy soil. Moreover, some clay minerals are able to include atoms irreversibly in their lattices. External radiation which results from the deposition of the radioactive material on the soil surface results in prevention of germination or sprouting, in a change of the morphological structure or in a decrease in the yield. The chemical and physical natures of the radionuclide must also be taken into consideration. (auth)

7789 A QUANTITATIVE MODEL OF THE TRANSPORT OF ^{137}Cs FROM FALLOUT TO MILK. Wilson, D. W.; Ward, G. M.; Johnson, J. E. (Colorado State Univ., Fort Collins). pp 125-34 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Atmospheric ^{137}Cs moves through the environment to milk by mechanisms that are now understood to a point that allows construction of an ecologically based quantitative model of the transport system, fallout to milk. Results of a comprehensive study of ^{137}Cs in a Colorado dairy farm (1962 to 1967) provided information on the mechanisms and quantitative values for rate constants. The model presented here is for the dry-lot feeding situation where cattle are fed stored feeds the year round. Surface air levels are used to describe the fallout rate to vegetation resulting in crop contamination and the direct fallout rate is shown to be of primary importance. Significant control of ^{137}Cs levels in milk, however, and lag between the fallout rate and the appearance of ^{137}Cs in milk is introduced by agricultural feeding practices. The model is applied to the single farm and is also generalized for application to milk levels across the United States of America. The dry lot model using surface air levels has proved to be generally applicable to milk sheds across the nation. Exceptional locations were explained on the basis of unique climatological and agronomical circumstances, such as those found in Florida. (auth)

7790 AGRICULTURAL ASPECTS OF ACUTE AND CHRONIC CONTAMINATION SITUATIONS. Bruce, R. S.; Russell, R. Scott (Agricultural Research Council Letcombe Lab., Wantage, Eng.). pp 79-89 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

When finely divided soluble radioactive substances are deposited on agricultural land, radiation doses to man will be due mainly to the consumption of contaminated foodstuffs. External radiation could dominate if the deposit were insoluble or if mixed fission products were deposited rapidly after instantaneous fission as the abundant short-lived nuclides could then give rise to considerable external doses in the initial period, but such situations are unlikely after peacetime accidents. The present discussion is therefore concerned with dietary contamination. From this viewpoint it is usually necessary to consider only ^{131}I, ^{89}Sr, ^{90}Sr, and ^{137}Cs; internal doses from these nuclides can be considerably higher when they are deposited on the land surface than on water. A relatively small number of pathways are responsible for the major part of the airborne radioactivity which reaches man's diet and the transfer to milk is often particularly important in Western countries. The principal factors which influence the transfer of radioactivity into diet are reviewed. In acute situations the highest levels of dietary contamination will be reached soon after deposition occurs, when the direct entrapment of the deposit on the foliage of plants is the dominant mode of entry into food chains. Although the rela-

tive importance of the critical nuclides may vary, the entry of ^{131}I into fresh milk is likely to be of greatest significance when land on which cattle are grazing is contaminated. Radiation dose due to dietary contamination would be much lower in other circumstances. When deposition is continuous, uptake from the soil and the plant base will also contribute to the contamination of diet with the longer-lived nuclides ^{90}Sr and ^{137}Cs. In these circumstances the quantitative relationships derived from surveys of world-wide fallout are likely to be applicable. (auth)

7791 ^{137}Cs IN THE U. S. DIET 1961–1968 AND THE INFLUENCE OF CLIMATIC AND AGRICULTURAL FACTORS. Gustafson, P. F. (Argonne National Lab., Ill.). pp 135-43 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

From 1961 through 1968 ^{137}Cs total accumulated deposition in the United States increased three-fold, while the rate of ^{137}Cs deposition varied by a factor of ~10, and its average concentration in the diet varied by a factor of ~5. After reaching maximal levels in 1963 and 1964, both the deposition rate and diet levels have diminished with a half-time of between 12 and 18 months, clearly indicating a close relation between these two parameters. The near steady-state reached in 1967 and 1968 caused by new inputs, and possible recycling of ^{137}Cs are discussed. Delays between the production and consumption of foodstuffs as well as the growing period itself cause diet levels to lag behind deposition and to exhibit less pronounced variations with time. In general, the total diet contains locally-produced and imported commodities. Milk is the most abundant locally produced food item, the origin of fruits and vegetables varies seasonally, whereas meat and grain products are likely to come from discrete geographic regions. The nation-wide food distribution network coupled with precipitation patterns that cause comparable fallout levels over wide areas during the critical growing months has resulted in a remarkably uniform ^{137}Cs level in the US diet. Total ^{137}Cs accumulation varies by nearly five-fold over the USA, yet diet levels and the resultant body burden in man differ by less than a factor of two. Exceptions due to concentrating mechanisms are discussed. The observed uniformity in dietary ^{137}Cs levels has led to a derivation of a model of dietary contamination (and population radiation exposure) in terms of weighted ^{137}Cs deposition. This relation may prove useful in both cases of local environmental release of ^{137}Cs and its atmospheric injection on a global scale. (auth)

7792 BEHAVIOUR OF ^{137}Cs-TAGGED PARTICLES IN A FESCUE MEADOW. Dahlman, R. C.; Auerbach, S. I.; Dunaway, P. B. (Oak Ridge National Lab., Tenn.). pp 153-65 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Enclosures of tall fescue (Festuca arundinacea), 0.01 hectare in area, were contaminated at the rate of 25 g/ft^2 using artificial fallout (^{137}Cs fused to 88 to 177 μm silica sand, ~100 μCi/g, 15% leachable in water) to study the effects of close-in fallout on a grass system. Investigations of radiation effects, intercompartmental cycling of radiocesium and secondary movements of the simulant particles in soil and litter have been in progress since mid-summer, 1968. Plant community response (yield, seed production, and species composition), small mammal physiology (hemopoietic and gut effects) and insect population dynamics are being studied following exposure to chronic, internal-external, beta-gamma radiation. Sand particles intercepted by grass blades were readily dislodged by light wind, and maximum retention time was approximately 10 days. The simulant was readily trapped in the leaf axils where it remained for 4 weeks until washed off by rain. There was significant transfer (15%) of ^{137}Cs from simulant to vegetation. Vacuum and brush-cleaned vegetation initially contained 1.32 μCi/g (living parts) and 4.62 μCi/g (dead parts). Early incorporation into foliage was largely by contact assimilation because appreciable uptake had occurred before the simulant had reached the soil. Two loss rates were evident in the subsequent decrease of ^{137}Cs in living foliage. The fast component, which began 8 days after contamination and continued for 4 weeks, was described by the linear regression $Y = 1.64 - 0.04\ X$ where Y and X are μCi ^{137}Cs/g foliage and days, respectively. The slower loss rate commenced 4 weeks after contamination and its regression was $Y = 0.61 - 0.003\ X$. Only 0.12 mCi of ^{137}Cs (0.006% of that present) was carried from the tagged areas in one runoff event. This agreed remarkably well with that predicted from a simple model based on characteristics of simulant and soil and on rainfall-runoff relations. (auth)

7793 AQUATIC ASPECTS IN CHRONIC AND ACUTE CONTAMINATION SITUATIONS. Preston, A.; Jefferies, D. F. (Ministry of Agriculture, Fisheries, and Food, Lowestoft, Eng.). pp 183-211 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The present state of knowledge of the behavior of radionuclides in the aquatic environment and the potential consequences for public health are reviewed. Data are given illustrating the average concentration in water, sediment, and biota of both naturally occurring radionuclides and those derived from nuclear weapon testing. The behavior of radionuclides deliberately introduced into the aquatic environment under controlled disposal conditions is examined. Distributions of radionuclides in water, sediment, and biota in the vicinity of waste disposal sites are illustrated as both a function of time and space. Reconcentration factors in the form ([Radionuclide] material/[Radionuclide] water) are derived and combined with radionuclide toxicity to provide a ranking order for hazard assessment. Data and experience gained from controlled disposal operations are used for an assessment of the consequences of a large release in a shallow coastal water environment. (89 references.) (auth)

7794 RELATIVE IMPORTANCE OF WATER AND SOIL IN THE INDIRECT RADIOCESIUM AND RADIOCOBALT CONTAMINATION OF IRRIGATED RICE FIELDS. Myttenaere, C. (EURATOM, Ispra, Italy); Bourdeau, Ph.; Bittel, R. pp 175-82 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969). (In French).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Tests involving models of irrigated rice fields with double labeling for each element have shown that transfer to the plant from water is much greater than from the soil (by a factor of 7 to 12 in the case of cobalt and 30 to 100 in that of cesium). The water-plant transfer rates are comparable to those obtained in aquiculture. The soil fixes the two elements strongly. EDTA reduces radioactive cobalt fixation and its absorption by the plant, thus leading to transport of the contamination over a greater distance. (auth)

7795 SOME THOUGHTS ABOUT RADIOACTIVE CONTAMINATION OF THE ENVIRONMENT FROM PEACETIME APPLICATIONS OF ATOMIC ENERGY. Comar, C. L. (Cornell Univ., Ithaca, N. Y.). pp 91-7 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The present is an important turning point in regard to radioactive contamination of the environment. Past experience has been gained mainly from the testing of nuclear weapons. This experience and the mistakes made should be benefitted from as much as possible to cope with the new type of problems that are to arise from widespread peacetime application of atomic energy. An important new factor is the increasing need to consider public reaction, which may limit the development of nuclear applications and this matter is discussed. The major principles that have emerged from fallout studies, especially the identification of critical factors, are applicable with appropriate modifications to problems of peacetime application. Caution should be taken to avoid the type of mistake made in the past which includes: neglect of ^{131}I as a radiation hazard; neglect of surface phenomena; growth of uncoordinated monitoring programs; confusion over action guides and standards; and lack of adequate standards for uranium miners. (auth)

7796 ACCUMULATION OF ^{137}Cs BY BLACK SEA HYPONEISTON. Strogonov, A. A.; Lisachenko, E. P. (Inst. of Biology of the Southern Seas, Sevastopol. Inst. of Radiation Hygiene, Leningrad). Radiobiologiya; 9: 603-7(Jul-Aug 1969). (In Russian).

A pronounced and statistically significant seasonal variation of the coefficients of accumulation and concentration of ^{137}Cs by Black Sea hyponeiston was established. The maximum coefficients of accumulation (up to 2000) were noted in samples with a large amount of organic detritus and a predominance of planktohyponeiston. From the equality of the coefficients of stable and radiocesium, it is concluded that a total isotopic exchange is established between them in the hyponeiston. (tr-auth)

Genetics and Cytogenetics

Refer also to abstracts 7727, 7730, 7743, 7757, 8005, 8023, 8026, and 8029.

7797 (BNL–14118) RBE OF X RAYS AND 0.43-MeV MONOENERGETIC NEUTRONS ON SOMATIC MUTATIONS AND LOSS OF REPRODUCTIVE INTEGRITY IN TRADESCANTIA STAMEN HAIRS. Underbrink, A. G.; Sparrow, Rhoda C.; Sparrow, A. H.; Rossi, H. H. (Brookhaven National Lab., Upton, N. Y. Columbia Univ., New York. Radiological Research Lab.). [1969]. 23p. (CONF-691106–3). Dep. CFSTI.

From Symposium on Neutrons in Radiobiology, Oak Ridge, Tenn.

Young inflorescences of Tradescantia clone 02 were irradiated with 0.43-MeV neutrons at doses of 0.163, 0.54, 1.07, 2.16, 4.34, 7.97, 12.7, 17.2, and 24.4 rads. Data from this experiment were compared with data from 250-kVp x rays with exposures of 11.5, 24.0, 48.0, 96.0, 144.0, 192.0, 240.0, 288.0, and 432.0 rads. In both experiments, the stamen hairs were scored daily from day 7 through day 23 postirradiation. RBE values were determined for four cellular aberrations: the color change from blue to pink and to colorless, and the morphological change from normal-sized blue cells to either blue dwarf or blue giant cells. Maximum RBE values found were 23.5 for blue dwarf, 30.7 for pink, 39.1 for colorless, and 120.5 for blue giant cells. In all cases, the RBE decreased with increasing dose but only slightly so for blue dwarf cells. Survival curves were constructed with hairs of three different lengths (cell numbers) being considered as the surviving fraction. RBE values of about 10 were found for 50% loss of reproductive integrity. The reason for the large variation in RBE obtained with the different criteria used as end points are not understood. (auth)

7798 EFFECTS OF GAMMA RAYS ON APPLE AND PEACH LEAF BUDS AT DIFFERENT STAGES OF DEVELOPMENT. I. SURVIVAL, GROWTH, AND MUTATION FREQUENCIES. Lapins, K. O. (Canada Dept. of Agriculture, Summerland, British Columbia); Bailey, Catherine H.; Hough, L. F. Radiat. Bot.; 9: 379–89(Oct 1969).

In the search for efficient methods of inducing useful mutants in fruit trees, attempts were made to relate detectable somatic mutations to developmental stages of irradiated leaf buds and to identify the portion of the irradiated plant that is likely to give the highest yield of mutants. Very young seedlings from embryo culture and leaf buds at different stages of development in apple and peach were subjected to various exposures of gamma rays from ^{60}Co sources. Mutations in morphology and in deficiencies of anthocyanins and chlorophyll of the leaf were studied in primary and secondary shoots originating from irradiated buds. The irradiation of physiologically active meristems, such as forced winter buds in apple and tip buds of actively growing seedlings in peach, tended to give higher mutation frequencies than treatment of the less active tissue, such as dormant winter buds in apple and semiactive summer buds in peach. Conditions favoring extensive division of cells immediately after irradiation appeared to assist mutated cells in competition with non-affected cells. Following exposures of 2.0 and 3.5 kR, administered at the rate of 800 R/min, the greatest frequency of mutations was produced in the zone of the primary shoot, which included the shoot apex with the youngest leaf primordia. High doses and high dose rates resulted in high mortality, large sectors of mutated tissue, and concentration of mutations in the area of the primary shoot where axillary buds had been partly developed at the time of irradiation. Exposures of buds to 3.5 and 5.0 kR at the rate of 800 R/min resulted in over 50 per cent survival of plants with relatively high rates of mutations. Survival was remarkably influenced by environmental conditions following irradiation. Dose rates affected both the survival of buds and the rate of initial growth, an indication that chromosomal damage was involved. Thus in peach seedlings the LD_{50} values were 15 kR at the rate of 12 R/min and 3.7 kR at 800 R/min. The delay for initiation of normal growth for the two dose-rate groups was, respectively, 2.5–3.0 days and 10 days per kR of exposure. (auth) (UK)

7799 DOUBLING-TENDENCY MORPHOLOGICAL CHANGES INDUCED BY DIFFERENT MUTAGENS IN BARLEY. Sethi, G. S.; Gill, K. S. (Punjab Agricultural Univ., Ludhiana, India). Radiat. Bot.; 9: 415-19(Oct 1969).

Doubling-tendency aberrations induced by different mutagens comprised double spike, branched spike, branched tiller, double peduncle, double kernel, twelve-rowed spike-cum-double leaf and 6 rows ⇌ 9 rows. Whereas only double spike aberrations were observed in EMS and gamma-radiation treatments, all types of mentioned changes occurred in ^{32}P treatment, but ^{35}S did not produce such a change. The frequency of such changes was also exceptionally high in ^{32}P treatment. All these morphological changes recorded in M_1 were not inherited in the M_2 generation. Even after irradiating and growing in soils of varying fertility these changes were not carried to the subsequent generation. (auth) (UK)

7800 MUTAGENIC EFFECTS OF IONIZING RADIATIONS. Gorgidze, A. D. Soobshch. Akad. Nauk Gruz. SSR; 52: 797–8 (Dec 1968). (In Russian).

In order to study the radiosensitivity of plants and the biological value of different types and doses of ionizing radiations, the anhydrous seeds of certain species of polyploid wheat were irradiated with γ rays and neutrons. The irradiation was conducted in Moscow, in the laboratory of radiation genetics of the Institute of Biophysics Acad. Sci. USSR. Seeds were γ-irradiated at a dose rate of 700 R/min to a total dose of 5, 8, 10, 15, 20, or 25×10^3 R. The conditions of irradiation by fast neutrons were 100 rad of fast neutrons +38 rad of γ rays, 150 rad of fast neutrons +57 rad of γ rays, and 200 rad of fast neutrons +76 rad of γ rays. The results of the experiments showed that ionizing radiations have an effect on the vitality (growth and development) of wheat and cause greater changes in the early stages of development of the plants. These changes depend on doses and types of radiations and also on the ploidy of the plant and on the periods of sowing of irradiated seeds. The mutagenic effects of ionizing radiations were studied. In the generations of irradiated populations of wheat, the incidence of hereditary neoplasms was established. It was established among diploid, tetraploid, and hexaploid species of wheat. From the preceding, of special interest was the establishment of neoplasms in diploid population crossed with tetraploids and in tetraploid populations from octaploid species. Cytogenetic analysis of the mutants confirmed the formation of tetraploid species from diploid species. Species formation in populations from diploid-tetraploid crosses are possible by the polyploidization of the original species. Thus, for example, if the genome structure of the diploid species is indicated as AA, then as a result of polyploidization, the tetraploid species genome structure will be AAAA, and for the hexaploid species—AAAAAA. In heterozygous populations, the formation of species by polyploidization is partially confirmed also by the existence of a general karyotype for all of the three forms of the given population. Thus the tetraploidgenome structure (AAGG), proposed by Lilienfeld and Kihara, must be replaced by the structure (AAAA) which represents a doubling of the genes of the initial species (AA). (tr-auth)

7801 THE INFLUENCE OF HETEROCHROMATIN, INVERSION-HETEROZYGOSITY AND SOMATIC PAIRING ON X-RAY INDUCED MITOTIC RECOMBINATION IN DROSOPHILA MELANOGASTER. Becker, Hans Joachim (Univ. Munich). Mol. Gen. Genet.; 105: 203-18(3 Nov 1969).

Mitotic recombination was induced with x rays in Drosophila melanogaster larvae and assayed later as twin mosaic spots in the adult eyes. When the X-chromosomes are marked with zeste and white and the third chromosomes with roughoid and sepia, the frequency of twin spots was about 20 times higher for the X-chromosome than for the third chromosome. The greater amount of heterochromatin in the X-chromosome was considered responsible for the difference. Experiments with different inversion heterozygotes support this interpretation. Euchromatic inversions of different lengths have, when heterozygous, little or no influence on the twin spot frequency. The shorter the heterochromatic segment between the kinetochore and the proximal break point of the inversion the stronger is the reduction of the twin spot frequency. The heterozygotes for the long sc^8 and sc^{51} inversions gave exceptionally low twin spot frequencies. It seems possible that potential twin spot daughter cells die after recombination because of genetic imbalance and/or lack of proper cell separation resulting from the persistence of the dikinetic chromosome elements. To test whether inaccurate somatic pairing in inversion heterozygotes could help explain the low twin spot frequencies in those of sc^8 and sc^{51}, neuroblast chromosomes were investigated. They show that chromosomal arrangement during metaphase is determined exclusively by the location of the kinetochore, which always points, irrespective of earlier somatic pairing, toward the center of the metaphase plate. It is possible that there is a lack of proper chromosome alignment at the x-ray sensitive stage for mitotic recombination. (auth)

7802 A POSSIBLE EXAMPLE OF A GENE AFFECTING ALLELIC RECOMBINATION IN DROSOPHILA MELANOGASTER. Sheldon, B. L.; Rendel, J. M.; Finlay, D. E. (Commonwealth Scientific and Industrial Research Organization, Epping, New South Wales). Genetics; 63: 155-65(Sep 1969).

Reversion from scute to wild type occurs with a high frequency in a scute population that was canalized by artificial selection at two scutellar bristles. Back-cross experiments show that reversion is due mainly to the selected background, but there is some evidence of general instability in the scute region of the X chromo-

some of the selected population. Reversion occurs at least partly premeiotically and only in the female parent. The selected background may have a gene that both increases recombination at the scute locus and regulates the activity of the scute locus. (auth)

7803 EXCHANGES AT THE BOBBED LOCUS OF DROSOPHILA MELANOGASTER. Schalet, A. (Univ. of Connecticut, Storrs). Genetics; 63: 133-53(Sep 1969).

A scheme is described that permits the selection of interhomologue exchanges within the distally located bb locus of a sc^8 inversion chromosome. Each recombinant chromosome carries an x-radioinduced mutant allele of bb that generally remains stable when maintained in the male line. Some alleles are readily distinguishable from one another and the parental bb phenotypes. The wide range of phenotypes is consonant with the structure proposed for the bb locus by Ritossa, Atwood, and Spiegelman. Accordingly, the bb locus consists of a linear array of tandemly repeated genes; and the various alleles, with different degrees of hypomorphism, have different numbers of genes generated by asymmetrical pairing and interhomologue exchange throughout the locus. The distribution of phenotypes among 52 recombinants suggests an excess of the more extreme alleles, but this distribution may not be primarily related to the process of pairing and exchange within bb. The frequency of exchanges is estimated at 0.8% for the first 3 or 4 days of oviposition but declines rapidly during the latter half of the first week so that the total for the first week is 0.4%. Since the total number of genes for both parental bb loci, and the influence of the relative lengths of both loci is not known, this frequency may be an underestimate. Among the progeny of a recombination experiment, female offspring appear that differ in their bb phenotype from the parental chromosomes but are nonrecombinant for outside markers. The bb alleles of these chromosomes generally remain stable when maintained heterozygously in females that have X chromosome crossing-over suppressed. These nonrecombinant bb alleles may have originated by intrachromosomal exchange within the germ cells of parental females. The deficient nature of bb in the parental chromosomes, the variety of bb phenotypes generated by interhomologue exchanges, and the frequency of exchanges provide evidence against a master-slave structure for the bb locus. (auth)

7804 ISOLATION AND CHARACTERIZATION OF NUCLEAR MUTANTS IN NEUROSPORA CRASSA. Ishikawa, T.; Toh-E, A.; Uno, I.; Hasunuma, K. (Tokyo Univ.). Genetics; 63: 75-92(Sep 1969).

One hundred and sixty eight mutants that utilize neither RNA nor DNA as a sole source of phosphorus were isolated in Neurospora crassa. A single mutation results in a loss of ability to digest either RNA or DNA. Two genes, nuclease-1 (nuc-1) and nuclease-2 (nuc-2), were found to be responsible for such nucleic acid digestion. These mutants showed a reduced activity of a nuclease fraction, N_3, that was found in the wild-type cell extract and digested both RNA and DNA. After treatment with reagents such as monoiodoacetate or after incubation at 37°C, the N_3 fraction was transformed into another nuclease fraction N_3'. It was suggested that nuclease N_3 is a complex consisting of nuclease N_3' and an inhibitor molecule. Comparative studies of mutants indicated that the nuc-1 locus may be responsible for nuclease N_3' and the nuc-2 locus for the inhibitor. (auth)

7805 ENZYME REPRESSIBILITY AND REPRESSOR EFFECTIVENESS IN PHENOTYPIC REVERTANTS OF ARGININE AUXOTROPHS. Unger, Leon; Bacon, Donald F.; Vogel, Henry J. (Rutgers-The State Univ., New Brunswick, N. J.). Genetics; 63: 53-61(Sep 1969).

Arginine-repressed acetylornithinase activity, restored in phenotypic revertants of acetylornithinase mutants of Escherichia coli, strain W, ranges from 100% to 1% of the (arginine-repressed) wild-type level. The phenotypic revertants, isolated after uv irradiation, arise either by mutations that map in the region of the acetylornithinase locus or by suppressor mutations that are not closely linked to this locus. For all revertants, the ratio of depressed acetylornithinase levels in $argR^-$ derivatives to repressed acetylornithinase levels in the corresponding $argR^+$ strains remains constant. Acetylornithinase levels in the phenotypic revertants and the repressibility characteristics of this enzyme thus are separable phenomena, whether the revertant mutations occur at the acetylornithinase locus or not. For the ($argR^+$) revertants grown without added arginine, the steady-state intracellular arginine concentration appears to be independent of the acetylornithinase level until this level drops to approximately 10% of that of the wild type. For a revertant showing a 3% level, the intracellular arginine concentration, and hence the concentration of functional repressor, is indicated to be fully derepressive for acetylornithinase but partially repressive for two other arginine enzymes. Susceptibility to functional repressor, therefore, seems to vary among the enzyme-forming systems involved. (auth)

7806 CHARACTERISTICS OF SOME MULTIPLE RECOMBINATION-DEFICIENT STRAINS OF ESCHERICHIA COLI. Willetts, N. S.; Clark, A. J. (Univ. of California, Berkeley). J. Bacteriol.; 100: 231-9(Oct 1969).

Strains of Escherichia coli have been made carrying lesions in more than one gene determining recombination. The following genotypes were constructed and verified: recC22 recB21 $recA^+$, recC22 recB21 recA13, recC22 $recB^+$ recA13, and $recC^+$ recB21 recA13. All multiple rec^- strains carrying recA13 were similar to AB2463, which carries recA13 alone, in their uv sensitivities, recombination deficiencies, and inabilities to induce lambda phage in a lysogen. However, whereas AB2463 shows a high rate of ultraviolet (uv)-induced deoxyribonucleic acid (DNA) breakdown, the multiple rec^- strains showed the low level characteristic of strains carrying recC22 or recB21 alone. The strain carrying both recC22 and recB21 was similar in all properties to the single mutants, suggesting that both gene products act in the same part of the recombination and uv repair pathways. It is concluded that in a Rec^+ strain, the $recA^+$ product acts to inhibit DNA breakdown determined by the $recC^+$ and $recB^+$ products. (auth)

7807 EFFECTS OF QUINOID AND PHENOLIC ANALOGS OF RADIOTOXINS ON THE CHROMOSOME APPARATUS. Krogulevich, R. E.; Stom, D. S. (Siberian Inst. of Plant Physiology and Biochemistry, Irkutsk, USSR). Radiobiologiya; 9: 644-7(Jul-Aug 1969). (In Russian).

The effects of benzoquinones and their phenols on the behavior of the chromosomes in onion root cells were compared. Treatment with solutions of p- and o-quinones ($5 \cdot 10^{-3}$ M) for 15 min led to fusion of the chromosomes, the formation of bridges and fragments. Under the same conditions, hydroquinone and pyrocatechol did not produce any visible disturbances. Thickening of the chromosomes was noted after five-hour treatment with o-, p-, and m-dihydroxybenzenes ($1 \cdot 10^{-2}$ M), as well as with p-quinone (16 hrs) in a concentration of $2 \cdot 10^{-4}$ M. (tr-auth)

7808 DEPENDENCE OF THE CYTOGENETIC DAMAGE ON THE DOSE RATE. I. EFFECT OF DOSE RATE IN THE IRRADIATION OF DORMANT PEA SEEDS WITH THE γ RAYS OF ^{60}Co. Tsarapkin, L. S.; Tsarapkina, K. A. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya; 9: 589-95(Jul-Aug 1969). (In Russian).

Dormant pea seeds with a water content of 16 to 18% were irradiated with the γ rays of ^{60}Co at doses from 10 to 60 krad and dose rates of 5000 and 50 rad/min. The chromosome aberrations were analyzed in the anaphases of the root meristem. For all the types of chromosome changes studied, a lower injurious effect of γ rays with dose rate 5000 rad/min was established. (tr-auth)

7809 EVOLUTION OF FITNESS. V. RATE OF EVOLUTION OF IRRADIATED POPULATIONS OF DROSPHILA. Ayala, Francisco J. (Rockefeller Univ., N. Y.). Proc. Nat. Acad. Sci. U. S., 63: 790-3(July 1969).

Measurable evolution occurs in laboratory populations of Drosophila under strong natural selection. The rate of adaptation to the experimental environment is significantly greater in populations with genetic variability increased by radiation than in the control, nonirradiated populations. (auth)

7810 CHROMOSOMAL FRAGMENTS TRANSMITTED THROUGH THREE GENERATIONS IN ONCOPELTUS (HEMIPTERA). LaChance, Leo. E.; Degrugillier, Maurice (Dept. of Agriculture, Fargo, N. D.). Science, 166: 235-6(Oct. 10, 1969).

Chromosomal fragments and translocations induced by x rays in the sperm of adult milkweed bugs, Oncopeltus fasciatus (Dallas), were detected in the meiotic cells of F_1, F_2, and F_3 males and caused high levels of sterility in untreated progeny. The persistence of these fragments through numerous generations of cells confirmed the holokinetic nature of the milkweed bug chromosomes. (auth)

7811 CHROMOSOMAL ABERRATIONS INDUCED BY PLASMA FROM IRRADIATED PATIENTS: AN INDIRECT EFFECT OF X RADIATION. FURTHER OBSERVATIONS AND STUDIES OF A CONTROL POPULATION. Littlefield, L. Gayle; Hollowell, Joseph G. Jr.; Pool, W. H. (Medical Coll. of Georgia, Augusta). Radiology, 93: 879-86(Oct. 1969).

Plasma from patients who had received therapeutic x radiation (0.16 to 25×10^6 g R) for various tumors produced a significant increase in the frequency of chromatid and chromosome aberrations of nonirradiated leukocytes in short-term cell culture. For control cultures plasma was used from patients with tumors before x-ray treatment, nonirradiated homologous plasma, and nonirradiated autologous plasma. The presence of the plasma chromosome breakage factor was interpreted to support the hypothesis that x radiation can exert an indirect effect on chromosomes. The

material was thought to be released from the tumors during x-ray therapy. This could account for the decrease in the effect at higher dosage when there was less tumor remaining for damage by the radiation. The identity of the "chromosome breakage factor" and the mechanism by which it operates are not known. (auth)

Health Physics and Safety

Refer also to abstracts 7400, 7544, 7589, and 7592.

Radioactive Contamination and Decontamination

Refer also to abstracts 7496, 7624, 7711, 7720, 7721, 7768, 7769, 7771, 7781–7784, 7789–7795, 7848–7850, 7874, 7875, 7879, and 8008.

7812 (ARH-SA-54) HEALTH PHYSICS AND THE OCCUPATIONAL HEALTH NURSE. Anderson, R. D. (Atlantic Richfield Hanford Co., Richland, Wash.). Nov. 5, 1969. 8p. Dep. CFSTI.

An outline of a lecture to occupational health nurses in the nuclear industry is presented and documented by six pictures. Accidental contamination with radioactive substances of both skin and nasal passages are stressed. Decontamination procedures performed by health physics groups and by medical personnel are briefly discussed. (H.B.G.)

7813 (CEA-R-3785) CHANGES IN THE PROCESSING OF HEAVY α-CONTAMINATED EQUIPMENT AT THE MARCOULE CENTER. Seyfried, Philippe (Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule). Sept. 1969. 17p. (In French). Dep. CFSTI (U. S. Sales Only).

The processing of heavy α-contaminated equipment at the Marcoule Centre has been carried out for a long time by a rather expensive manual method. It was necessary to reduce these costs by using more automated methods. Two studies which were carried out have shown that when the amount of waste to be treated is large and is composed mainly of plastic material, it is possible to design economic installations using cooling and shock demolition, conventional compaction leading to rather poor results. For average quantities, a cutting-up reservoir, used also for other purposes, makes it possible to solve these processing problems at Marcoule. The costs involved are much lower than those previously required in the case of so-called manual methods. (auth)

7814 (COO-414-13) DETAILED CHARACTERIZATION OF SOIL AND VEGETATION ON SELECTED SITES TO SERVE AS BASIS FOR FUTURE EVALUATION OF EFFECT OF RADIOACTIVE CONTAMINATION. Technical Progress Report, March 1, 1969–November 26, 1969. Haghiri, F. (Ohio Agricultural Research and Development Center, Wooster). 26 Nov 1969. Contract AT(11-1)-414. 73p. Dep. CFSTI.

The movement of ^{90}Sr in the soil profile and the removal of ^{90}Sr by runoff, leachate, and plants uptake as influenced by soil and crop management practices are presented. Over a 7 yr period, the net rate of ^{90}Sr loss from 0 to 4 inch depth by various processes was maximum under gravel mulch and minimum under permanent grass cropping systems. The distribution of ^{90}Sr in the top 12 inches of soil profile was influenced by cropping system and liming. The concentration of ^{90}Sr at 3 to 12 inch depth under gravel mulch was approximately 10 times higher than permanent grass system. The application of high rates of lime reduced the downward movement of ^{90}Sr. The percent of the initial application of ^{90}Sr removed by runoff decreased while its loss by leachate increased during the 7 yr period. The distribution of ^{90}Sr in various parts of the winter wheat plant during 1968 to 1969 was 65% in straw, 27% in chaff, and 8% in grain. The distribution of ^{90}Sr in corn fodder was 99% while in shelled corn it was 1% of the total ^{90}Sr taken up by the corn plant. The total percent ^{90}Sr removed by runoff, leachate, and plant uptake after a 7 yr period was 16.407, 13.655, 12.481, 10.828, and 9.231 for gravel mulch, rotation a (low lime), continuous corn, rotation b (high lime), and permanent grass respectively. The effects of various rates of fenac, benzac, trifluralin, CIPC, Pyramin, and diquat herbicides on the adsorption of ^{90}Sr by soil were studied. Among these herbicides, diquat was the most effective in releasing from soil or reducing the adsorption of ^{90}Sr by soil. Its effect was more pronounced under low than high pH soil. High rates of lime had a depressing effect on the removal of ^{90}Sr-^{90}Y by leaching with water in the presence of paraquat herbicide. Paraquat appears to be most effective in replacing strontium ion in acid soils with low clay and low organic matter contents. The two soils (Dunbar and Lynchburg), furnished by the USDA, were treated with Sr^{++} and the retention of Sr^{++} was compared to other soils. The curves for the adsorption and displacement of ^{90}Sr was similar to the soils used in previous experiments and reported in earlier reports. The non-displaceable Sr was approximately 30% of the total adsorbed. Soil samples were analyzed for boron content after the samples were methylated at various rates of BF_3–MeOH. The boron content of the samples increased with increasing rates of BF_3. Therefore, methylation of soil organic matter with the BF_3 method is of a limited value in soil's work. It would be of value in soil organic matter fractions that contain compounds that are not reactive with BF_3, for example fatty acids. The sample of runoff water from micro-plots was electrodialyzed and ^{90}Sr was detected in the anode chamber. The sample is being fractionated for IR and gas chromatographic analyses. The distribution of ^{90}Sr from soybean and corn tissue in soil columns was determined. The least movement was in the muck soil column and the most movement in the Wooster soil column. There were no conclusive differences between the tissues. (auth)

7815 (EIR-161) ^{41}Ar MEASUREMENT IN THE ENVIRONS OF THE FEDERAL INSTITUTE FOR REACTOR RESEARCH IN WUERENLINGEN. Nagel, E. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). July 1969. 18p. (In German). Dep. CFSTI (U. S. Sales Only).

Air flow from the stack of the heavy water reactor DIORIT was monitored. Activity of argon-41, serving as indicator, was measured with a mobile scintillation counter. At distances from one to three km downwind from the stack dose rates generally were less than 20 micro rem per hour; rarely, maximal values of 100 to 200 micro rem per hour were observed. Flow patterns as determined by wind direction and velocity as well as topographical features of the surroundings are depicted. (H.B.G.)

7816 (TID-25077) PLANETARY QUARANTINE PROGRAM. Twelfth Quarterly Progress Report for Period Ending March 31, 1969. (Sandia Labs., Albuquerque, N. Mex.). Mar. 1969. 22p. Dep. CFSTI.

Progress is reported on contamination control study, bioburden experimentation and modeling, lunar information system, sterilization modeling, and laboratory support work. Figures are presented to show vertical laminar airflow research facility; number of viable particles per two-minute intervals; and ratio of number of particles vs angle. (H.L.W.)

7817 ON THE DIRECT CONTAMINATION OF RYE, BARLEY, WHEAT, AND OATS WITH ^{85}Sr, ^{134}Cs, ^{54}Mn, AND ^{141}Ce. Aarkrog, A. (Danish Atomic Energy Commission, Risoe). Radiat. Bot.; 9: 357-66(Oct 1969).

Radionuclides of Sr, Cs, Mn and Ce were applied as a spray to spring varieties of rye, oats, barley, and wheat at four different stages of development. The Cs and Mn concentrations in the grain were higher than the concentrations of Sr and Ce. The ratios Cs/Sr, Cs/Ce, Mn/Sr, Mn/Ce, and Sr/Ce in the grain increased with the time between spraying and maturity. Field loss of Sr was greater than for the other nuclides applied. The "half-lives" for the Sr-loss was calculated as about 3 weeks as compared to 4 to 5 weeks for Mn and Ce and probably even longer for Cs. (auth) (UK)

7818 RAPID DETERMINATION OF ^{90}Sr IN TISSUE, FOOD, BIOTA, AND OTHER ENVIRONMENTAL MEDIA BY TRIBUTYL PHOSPHATE. Baratta, Edmond J.; Reavey, Thomas C. (Dept. of Health, Education, and Welfare, Winchester, Mass.). J. Agr. Food Chem.; 17: 1337-9(Nov-Dec 1969).

In a rapid method for the determination of strontium-90 by tributyl phosphate extraction strontium-90 is determined by separation and analysis of its daughter product yttrium-90. The method is applicable to human tissue, food, biota, and other environmental media. For these types of samples, strontium-90 and its daughter, yttrium-90, are usually known to be in equilibrium. The method is sensitive to less than 1 pCi per sample of tissue or food ash. The samples are prepared by either dry- or wet-ashing techniques. The sample prepared for analysis is solubilized in nitric acid. The yttrium-90 daughter is extracted into equilibrated tributyl phosphate. The separated yttrium-90 is further purified by selective stripping and fluoride precipitation to remove the remaining contaminants which may have been carried over. Strontium-89 can also be determined in the same sample by precipitation of strontium prior to the yttrium-90 extraction. (auth)

7819 EVALUATION OF CLAYS AS BINDING AGENTS FOR REDUCTION OF RADIONUCLIDES IN MILK. BINDING PROPERTIES OF CLAYS WITH ^{134}Cs IN ARTIFICIAL RUMEN AND IN SIMULATED ABOMASAL AND INTESTINAL FLUIDS, AND UPTAKE OF ^{134}Cs BY RUMEN MICROFLORA. Barth, Julius; Bruckner, Benjamin H. (Dept. of Health, Education, and Welfare, Rockville, Md.). J. Agr. Food Chem.; 17: 1344-6(Nov-Dec 1969).

The binding properties of ^{134}Cs by the natural and hydrogen

form of sodium and calcium montmorillonite clays and kaolin were tested in an artificial rumen and simulated fluids of the abomasum and jejunum. Natural Belle Fourche bentonite (sodium montmorillonite) removed 82% of the radioactivity from the rumen juice. Natural Aberdeen bentonite (calcium montmorillonite) removed 69% of the ^{134}Cs from the rumen juice. In both instances there was dissociation of the clay cesium complex with some of the ^{134}Cs returning into the abomasal and intestinal fluids. Hydrogen form Aberdeen bentonite removed 72% of the ^{134}Cs from the rumen juice. Following the intestinal phase, 57% of the radioactivity remained bound to the clay. The binding properties of Belle Fourche bentonite for ^{134}Cs decreased considerably when this clay was converted to the hydrogen form. Kaolin had no effect of practical significance. Results of an in vitro artificial rumen study to determine the extent of concentration of radiocesium by rumen microflora showed that less than 3% of the total radioactivity was associated with the microflora and other sediment. (auth)

7820 EVALUATION OF CLAYS AS BINDING AGENTS FOR REDUCTION OF RADIONUCLIDES IN MILK. EFFECT OF BELLE FOURCHE BENTONITE ON EXCRETION OF ^{134}Cs IN LACTATING GOATS. Barth, Julius; Mikalis, A. N.; Harris, J. Y.; Bruckner, B. H. (Dept. of Health, Education, and Welfare, Rockville, Md.). J. Agr. Food Chem.; 17: 1347-9(Nov-Dec 1969).

Sodium montmorillonite (Belle Fourche bentonite) effectively reduced the secretion of a single oral dose of ^{134}Cs in the milk of lactating goats when added to the ration at levels of 4 and 8% of the concentrate. The blood levels and urinary excretion of ^{134}Cs were reduced and the fecal excretion of ^{134}Cs was increased considerably. (auth)

7821 POPULATION DOSE AS CRITERION FOR AN ENVIRONMENTAL MONITORING PROGRAM. Alderhout, J. J.; Franke, T.; Hunzinger, W. (EUROCHEMIC, Mol, Belg.). pp 373-9 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

An environmental monitoring program must ensure that the radiological hazard to the population living in the vicinity of a nuclear establishment is acceptable. To establish an effective and economical routine monitoring program, the dose equivalents that are absorbed by the population due to the normal releases of radioactive material into the environment from the EUROCHEMIC reprocessing plant were calculated. The calculations take into account: the radionuclide and activity released through the stack (EUROCHEMIC does not release to the environment by other means); the dispersion of the radioactive material in the atmosphere as influenced by the meteorological conditions; the distribution of the population in the vicinity of the site; the radiological hazard due to inhalation of radioactive material, ingestion of contaminated foods, and external irradiation; and prolonged operation of the plant. These calculations resulted in dose equivalents received by the different critical organs of members of the public as a function of the operation time of the plant. The most hazardous radionuclide and the most critical pathway can be deduced from these results at any moment. Because the control of the environment is primarily based on a reliable stack monitoring system, the routine district survey program has thus to include the most significant radionuclides and the most significant samples with respect to the dose commitment of the population. From this it was concluded that only a very limited district monitoring program is necessary. (auth)

7822 STUDY OF RADIOACTIVITY IN THE DIET CARRIED OUT AT EDUCATIONAL ESTABLISHMENTS. Gahinet, Marie-Eve; Remy, Marie-Louise; Moroni, J. P.; Pellerin, P. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet, France). pp 357-72 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969). (In French).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

A systematic study of radioactivity in the diet of French adolescents carried out through a nationwide sampling network set up by SCRPI is described. The educational establishments chosen for the study were located in eight major centers that were representative of the principal geographic and climatic regions of France. Particular attention was paid to the local organization of the sampling operation in order to ensure reproducibility of the results obtained. Samples corresponding qualitatively and quantitatively to the food and drink intake of 12 to 15-year-old adolescents were collected each month over a period of seven consecutive days. The successive stages in the preparation of the samples before analysis are described. The initial results, obtained over the past three years, indicated that, as regards ^{90}Sr and ^{137}Cs, the observed differences in the level of radioactive contamination of the diet between one establishment and another corresponded to the differences found in the milk originating in the same regions. The educational establishments can be divided into four groups according to the level of radioactive contamination observed. (auth)

7823 ENVIRONMENTAL CONTAMINATION WITH FALLOUT FROM NUCLEAR WEAPONS. A REVIEW. Russell, R. Scott; Bruce, R. S. (Agricultural Research Council Letcombe Lab., Wantage, Eng.). pp 3-13 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The United Nations Scientific Committee on the Effects of Atomic Radiation has considered the integrated radiation doses, or dose commitment, which the population is expected to receive as a result of past weapons tests and compared them with doses due to natural background radiation. On the world average it is estimated that the dose delivered every eight months by natural background to the gonads is equal to the integrated dose which will be received by that tissue as a result from all past weapons tests until the year AD 2000. The corresponding figures for bone marrow and bone are about 18 and 30 months respectively. Considerable variations occur both in fall-out doses and in natural background, but it is evident that fall-out has on average been responsible for but a small increase in the total exposure to radiation of the world's population. Recent information on the behavior of ^{90}Sr suggests that its transfer to diet, integrated over an extended period, was formerly over-estimated by perhaps one third; moreover it is eliminated from the bones of the young more rapidly than was formerly believed. The transfer of ^{137}Cs through the food chain may have been somewhat under-estimated. The adequacy of present estimates of the dose commitment from weapons tests and the practicability of improving them is discussed. On balance UNSCEAR's assessment appears likely to have over-estimated rather than underestimated the average situation. However, having in mind the uncertainties inescapable from any such calculation and the small increase in the total radiation dose which fall-out has caused, it seems neither possible to improve estimates of dose commitment substantially nor necessary from the viewpoint of human welfare to devote effort to this subject. The usefulness of information hitherto obtained for predicting possible future situations and for designing reliable and economic survey procedures is emphasized. (auth)

7824 BEHAVIOUR OF THE URINE AND DIETARY C. U. AND S. U. RATIOS IN ITALIAN POPULATION GROUPS OF DIFFERING AGES. Cigna, A. (Centro Studi Nucleari della Casaccia, Rome); Mariani, A.; Migliaccio, P. A.; Spadoni, M. A.; Tomassi, G. pp 73-7 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

In research into the influence of some physiological factors of ^{137}Cs and ^{90}Sr contamination in the human body, three groups of Italian people between 15 and 80 years of age were examined. The ^{137}Cs and ^{90}Sr content of a 3-day diet and of the urine eliminated during the 24 hr corresponding to the last day of the diet collection were measured as were K and Ca. The results, compared with those of previous research, show that the S. U. diet/S. U. urine ratio varies according to age and is significantly lower in age groups with a higher growth rate, whereas there seems to be no significant variation with age in the CU diet/CU urine ratio. The meaning of these variations is discussed and their practical utility is underlined in reporting rapidly from urinary radiocontamination back to that of diet and body in monitoring and radiation protection programs. (auth)

7825 THE PLAN AND ORGANIZATION TO DEAL WITH LARGE-SCALE ACCIDENTS CAUSING ENVIRONMENTAL CONTAMINATION. Howells, H. (United Kingdom Atomic Energy Authority, Sellafield, Eng.). pp 587-96 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Planning first involves an assessment of the scale of the radiation accident for which it is reasonable to plan. This involves consideration of the probability of possible accident situations based on an assessment of anticipated frequency of occurrence and magnitude of radioactivity release. The organization of the emergency scheme to be applied will obviously depend on the magnitude of the postulated accident and the proposed remedial actions which may have to be initiated. Assessment of the effects of a release of radioactivity is made by environmental monitoring. The form of this monitoring survey is dependent on the nature and radiological significance of the radioactivity released by the accident. This significance can only be evaluated by comparison of measured activity levels with emergency reference levels. The latter are practical limits capable of comparison with instrument measurements in the field and derived from relevant emergency dose limits applicable to the conditions of the particular radiation accident. (auth)

7826 REMEDIAL MEASURES TO ALLEVIATE THE EFFECTS OF ENVIRONMENTAL CONTAMINATION WITH RADIOACTIVE SUBSTANCES: AGRICULTURAL ASPECTS. Russell, R. Scott (Agricultural Research Council Letcombe Lab., Wantage, Eng.). pp 657-66 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The usefulness of agricultural remedial measures must be judged in terms both of the extent to which they reduce risk from radiation and the magnitude of any new risks they create. The decontamination of the foodstuffs that contributes but a small fraction of the total radiation dose would confer little benefit and if a nuclide can enter the body both by inhalation and ingestion, as can happen with ^{131}I, the total intake by both routes must be considered conjointly. Consequently the suitability of measures to control dietary contamination is not determined solely by agricultural considerations, action should be decided by those authorities who have overall responsibility for human health. The contamination of milk with ^{131}I is the most likely occurrence that would necessitate remedial action, infants being particularly at risk. The provision of dried milk for them alone might be an adequate procedure, though if fresh milk was likely to cause unacceptable doses to the entire population, additional action might be required; the former situation is the most probable one. The short half-life of ^{131}I would under all circumstances enable contaminated milk to be safely used to manufacture foods with a reasonably long shelf life. The importance of educating the public to realize this in advance of any possible emergency is stressed. The isotopes of strontium and cesium are unlikely to create comparable problems after reactor accidents. Measures that have been suggested for reducing doses from these nuclides, including the decontamination of milk, are, however, reviewed. It would be impracticable to achieve any large reduction of the total radiation dose when there is widespread contamination with these nuclides; the magnitude of the social cost of attempting to do so would be considerable. (auth)

7827 FALLOUT ^{90}Sr LEVELS IN CANADA. Booth, A. H.; Samuels, E. R. (Dept. of National Health and Welfare, Ottawa). pp 393-402 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Data is presented for fallout ^{90}Sr levels in Canadian milk, wheat, whole diet, and human bone. Peak values occurred in 1963 and have since declined. A noteworthy feature of the milk data is the marked difference between the low values for Southern Ontario as compared with those for Quebec and New Brunswick. This is tentatively attributed to a basic difference in soil type, podzol in Quebec and grey-brown podzolic in Ontario. In wheat, the levels correlate with the rate of fallout deposition during the season of growth and the ^{90}Sr concentration per gram of calcium is higher than in milk. In the whole diet, the levels are intermediate between these two staples that are normally used as indicators. The human bone data show that the cohort of children born in 1962 reached a higher level than any other. In general, the levels, expressed in terms of picocuries per gram calcium, reached a peak in 1964 and are now declining; however, in terms of the total amount in the skeleton, the levels in some cohorts were still rising in 1968. (auth)

7828 BASIC AND DERIVED RADIOLOGICAL PROTECTION STANDARDS FOR THE EVALUATION OF ENVIRONMENTAL CONTAMINATION. Morley, F.; Bryant, Pamela M. (United Kingdom Atomic Energy Authority, Harwell, Eng.). pp 255-72 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

A review is given of the basic dose criteria for the evaluation and control of routine situations that are explicitly set out in the recommendations of ICRP and IAEA and that have been endorsed for use in the United Kingdom in the fields of radioactive waste disposal and the transport of radioactive materials. The practical application of these criteria frequently involves a careful analysis of the possible radiation exposure pathways and the precise identification and definition of critical groups in the population. Wide variations in critical pathways and groups result from differing local circumstances and examples are given that illustrate how limits expressed in terms of dose may be converted to derived working limits for activity in environmental materials. In the context of emergency planning no fixed dose criteria can be of general application since factors such as the availability and practicability of countermeasures must be taken into consideration. It is possible, however, to establish emergency reference levels of dose to identify situations in which countermeasures would be justified. These reference levels of dose may also be converted to derived levels of activity in environmental materials, thus facilitating the practical assessment of radiological standards. (auth)

7829 RADIOACTIVE CONTAMINATION ARISING FROM THE PEACEFUL USES OF ATOMIC ENERGY: PAST, PRESENT, AND FORESEEABLE FUTURE. Kenny, A. W. (Ministry of Housing and Local Government, London). pp 15-26 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The development of environmental contamination is traced from the occasional contamination by natural radionuclides before the war to the present world-wide contamination by ^{85}Kr and ^{3}H and local contamination by released fission products and buried trash. Techniques are available to limit this contamination to any desired level, except possibly in the case of tritium, and they should be sufficient for the control of environmental contamination as the industry grows. New developments such as nuclear civil explosives and power sources are discussed. Attention is drawn to the potentially serious hazard from loss of highly active sealed sources used in the field. (auth)

7830 ENVIRONMENTAL TRITIUM CONTAMINATION FROM INCREASING UTILIZATION OF NUCLEAR ENERGY SOURCES. Peterson, H. T. Jr.; Martin, J. E.; Weaver, C. L.; Harward, E. D. (Public Health Service, Washington, D. C.). pp 35-60 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Tritium is produced in nuclear reactors by ternary fission and by neutron capture reactions in ^{10}B, ^{11}B, ^{6}Li, ^{7}Li, ^{14}N, and ^{2}H. The expanding use of nuclear reactors for power production will contribute additional amounts of tritium to the existing background levels due to atmospheric testing of nuclear devices and natural production by cosmic-ray interactions in the upper atmosphere. Production processes, both in the environment and in nuclear and thermonuclear energy sources are reviewed. US power reactor experience indicates that the primary source of tritium production in boiling light-water reactors is ternary fission, while neutron capture reactions in ^{10}B and ^{7}Li are the principal sources in pressurized-water reactors employing chemical shim. Tritium from deuterium activation in heavy-water moderated reactors far exceeds the production of tritium by ternary fission. Environmental surveillance data show no apparent increase of tritium concentrations in water sources in the vicinity of light-water reactors. Because of tritium retention by the fuel cladding, a major portion of the tritium produced by ternary fission will be released during processing of the spent reactor fuel. Estimated releases from fuel reprocessing plants are compared with discharge data from operating plants. Forecasts of future tritium production from nuclear reactors are provided up until the year 2000. These estimates are compared with existing equilibrium levels of naturally occurring tritium and with the decreasing inventory of tritium remaining from atmospheric nuclear testing. The implications of these projections are evaluated from a public health viewpoint. A discussion of the possible impact of new thermonuclear energy sources on environmental tritium concentrations is also included. (auth)

7831 DATA. SECTION I. MILK AND FOOD. Radiol. Health Data Rep., 10: 435-50(Oct. 1969).

Data on radionuclide content of milk from 15 state surveillance programs are presented. Milk was the food item chosen since it

is the most useful indicator of the general population's intake of radionuclide contaminants resulting from environmental releases. Data are presented for the following radionuclides: ^{140}Ba, ^{137}Cs, ^{131}I, ^{89}Sr, and ^{90}Sr. Calcium and potassium were used as a means of assessing the behavior of metabolically similar radionuclides. Discussions are given concerning accuracy of data from various milk networks, development of a common reporting basis, Federal Radiation Council guidance applicable to milk surveillance, and data reporting format. Tables are presented to show surveillance results for June 1969, and the 12 month period, July 1968, to June 1969, in various locations throughout the United States. (H.L.W.)

7832 COMPARISON OF THE ^{137}Cs CONTENT OF MILK AND PEOPLE FROM 19 DAIRY FARMS IN UTAH. Lloyd, R. D. (Univ. of Utah, Salt Lake City); Mays, C. W.; Pendleton, R. C.; Clark, D. O. Radiol. Health Data Rep., 10: 427-33(Oct. 1969).

Measured cesium-137 concentration (pCi ^{137}Cs/g K) in milk from 19 Utah dairy farms and in residents of those farms, were compared for the period 1962 through 1966. During the time when cesium-137 levels were increasing (1962–1964), the cesium-137 to potassium ratios in people were similar to the ratios in milk produced by the dairy farm on which they resided. During the time when cesium-137 levels were decreasing (1964 to 1966), the ratios in people averaged about 2.5 to 4 times higher than the milk. Differences in biological half-times of cesium for men, women, and children are reflected in their respective body concentrations of cesium-137. This comparison suggests that measured cesium-137 to potassium ratios of milk might be used to estimate the cesium-137 concentration of a population with similar dietary habits during a corresponding time period without considering such factors as milk intake or the consumption of non-milk foods. Preliminary analysis of the relationship between milk levels and body cesium-137 concentration of individual subjects indicates that milk cesium-137 data can be used with appropriate human biological half-times to estimate the shape of human ^{137}Cs/K curves for the same time period. (auth)

7833 EVALUATION OF CLAYS AS BINDING AGENTS FOR REDUCTION OF RADIONUCLIDES IN MILK. BINDING PROPERTIES OF NATURAL AND HYDROGEN FORM CLAYS WITH STRONTIUM AND ESSENTIAL CATIONS IN ARTIFICIAL RUMEN AND IN SIMULATED ABOMASAL AND INTESTINAL FLUIDS. Barth, Julius; Bruckner, Benjamin H. (Dept. of Health, Education, and Welfare, Rockville, Md.). J. Agr. Food Chem.; 17: 1340-3(Nov-Dec 1969).

An in vitro screening device was developed to evaluate radionuclide binding materials for their possible use as feed additives in the diets of domestic ruminants to reduce the levels of radioactivity in milk and meat. Binding materials were tested first in an artificial rumen which was later converted to simulate the fluids of the abomasum and jejunum. A sodium and calcium montmorillonite clay and kaolin were tested in both their natural and hydrogen form. None of these clays tested removed Sr^{2+}, Ca^{2+}, Mg^{2+}, K^{+}, or Na^{+} from the rumen juice or simulated digestive fluids to any considerable degree. On the contrary, bivalent cations originally present on the montmorillonites were removed from the clays into the media, increasing the levels of Sr^{2+}, Ca^{2+}, and Mg^{2+}. This was especially true of the calcium clay. This occurred to a lesser extent when these clays were converted to the hydrogen form. (auth)

7834 A REVIEW OF RADIUM INCIDENTS IN THE UNITED STATES OF AMERICA. Villforth, J. C.; Robinson, E. W.; Wold, G. J. (Public Health Service, Rockville, Md.). pp 389-98 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

Radium has been in use longer than any other radioactive material. In the United States of America, the Federal Government has never had authority for the control of radium. This control has always resided in the individual State Governments and State control programs range from adequate to virtually non-existent. In 1963 the US Public Health Service began collecting reports of incidents involving radium. To date, the Bureau of Radiological Health, BRH, has collected and analyzed more than 400 reports of incidents which took place since 1905. This is the largest known collection of radium incident reports in this country and, perhaps, in the world. Twenty to thirty reports are now received yearly; these represent only a portion of the incidents which actually occur. Losses of sealed radium sources accounted for most reported incidents. Known, sudden ruptures of sealed sources totalled about 12% of the reported incidents. Statistics presented include number of radium losses, causes of loss, number of sources recovered, place of recovery, cause and result of contamination incidents and accidents, and chronological distribution of radium incidents. Representative radium contamination incidents are discussed and detailed recommendations are given for both remedial and preventive action. Twenty-six percent of radium losses during medical use occurred during patient irradiation and 47% occurred in the process of removal from the patient and transfer to the handling and storage area. In 34% of all radium losses recovery was not effected. In 54% of the incidents in which radium was lost from a medical facility and subsequently recovered, the recovery site was identified as an element of the trash system (generally the municipal dump). Among the group of known, sudden, radium source ruptures, 14% were apparently caused by internal pressure build-up, while 69% were caused by the accidental or inadvertent application of an external force. The sudden, accidental rupture of radium sources has in some instances resulted in massive contamination of medical or industrial facilities, necessitating costly decontamination and causing extensive losses of revenue. The apparent rate of occurrence of radium incidents in the United States of America increased almost continuously up to the early 1960s. Since the mid-1960s, the incident rate seems to have stabilized. Probable causes for these trends are discussed. (auth)

Dosimetry and Monitoring

Refer also to abstracts 7626, 7631, 7634, 7653, 7655, 7727, 7728, 7769, 7787, 7951, 7956, 7962, and 7963.

7835 (RD/B/M–1485) A REVIEW OF RECENT PROGRESS IN BONE DOSIMETRY AND ITS APPLICATION TO CEGB PROBLEMS. Wheatley, B. M. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Oct 1969. 13p. Dep. CFSTI (U. S. Sales Only).

The development of an arbitrary formula is traced by which the safety limits for bone seeking radioisotopes are determined is traced. It is then shown that recent work is making it possible to estimate actual doses from nuclides in bone. This could lead to a complete revision of permissible levels for many nuclides, and it is shown that, subject to further evidence, the permissible body burden of ^{90}Sr might be safely increased by a factor of 4.5. (auth) (UK)

7836 (RT/PROT–(69)17) EVALUATION OF THE ABSORBED DOSE TO A POPULATION IN THE CASE OF AN INCIDENT IN A NUCLEAR PLANT. Cardinale, A.; Nardi, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 17 Jan 1969. 31p. (In Italian). Dep. CFSTI (U. S. Sales Only).

Doses and derived reference levels to be used for evaluating situations following nuclear accidents were calculated. In such situations the risk caused by the accident is to be evaluated and compared with the consequences of radiation protection measures. Topics considered are fundamental and derived reference limits, irradiation, ingestion, inhalation, and submersion risks. (auth)

7837 SIZE AND UNITS OF MEASUREMENT FOR DOSIMETRY IN RADIODIAGNOSIS. Bossi, R. (Primario Radiologo Ospedali Riuniti Verbania, Novara, Italy); Ciancia, C.; Coucourde, F.; Rovera, S. Nunt. Radiol.; 34: 295-306(Apr 1968). (In Italian).

The sizes and the measurement units in radiodiagnostics are considered. It is concluded that at present the most suitable unit of measurement for the evaluation of the dose administered to the patient during radiodiagnostic examinations is that of one $R \times cm^2$. (auth)

7838 FAST-NEUTRON FACILITY FOR BIOLOGICAL EXPOSURES IN AN ARGONAUT REACTOR: DESIGN, TISSUE DOSIMETRY, AND NEUTRON SPECTROMETRY. Davids, J. A. G.; Mos, A. P. J.; De Oude, A. (Reactor Centrum Nederland, Petten, Netherlands). Phys. Med. Biol.; 14: 573-84(Oct 1969).

Small and medium-sized animals can be exposed to fast neutrons from a ^{235}U-converter. Studies using tissue-equivalent ionization chambers in combination with a neutron-insensitive γ-ray dosimeter have shown that the γ-ray and thermal neutron contaminations in the animal exposure field were small, amounting to 8% and 0.7% respectively of the total kerma. Forty mice may be irradiated simultaneously at the same fast-neutron center-line dose rate up to a maximum of 10 rad min^{-1}. The neutron spectrum, determined by proton-recoil spectrometry, gave a mean neutron energy of 1.04 MeV. For the first-collision recoil protons a track-average LET_∞ equal to 57 keV per μm was calculated. (auth) (UK)

7839 CONCERNING THE CORRELATION OF THE DISTRIBUTION OF RADIOACTIVITY AT DIFFERENT LEVELS OF THE

ATMOSPHERE. Styro, B. I.; Okroashvili, G. G.; Gamkhitashvili, L. V.; Khundzhua, T. G. (Inst. of Geophysics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 52: 635-8(Dec 1968). (In Russian).

Attempts were made to establish the correlation between the different values of radioactivity in the atmosphere obtained as a result of 30 flights in a specified area. Flights were made with the high altitude airplane-probe (IB-14) up to a height of 4.0 km. The samples of air were taken at the same heights, 0.5, 1.0, 2.0, 3.0, and 4.0 km and at a height of 3.5 M during non-flight times, i.e., on the surface layer of the atmosphere. All of the measurements were conducted in the second half of July and in August 1967. For free atmosphere, the functions of the internal correlation curve have sharply defined slopes for the initial parts, with a tendency to approach zero in proportion to the increase of the value of τ and the weak manifestation of periodicity. From this the following conclusions were made. Correlations were absent not only between distant, but also between adjacent measurements of concentration of natural radioactivity. For different heights in free atmosphere the nature of the correlations was almost identical. On the graphs of correlation functions for free atmosphere, in contrast to that for boundary layers, the periodic aspects of the initial chance processes are weakly reflected. In conclusion it should be noticed that the final parts of all of the correlation functions are roughly similar in their findings and therefore the conclusions were drawn only on the basis of 20 values. (tr-auth)

7840 RADIATION DOSIMETRY FOR THE RESPIRATORY TRACT OF URANIUM MINERS. Holleman, Dan Foy. Fort Collins, Colo.; Colorado State Univ. (1968). 154p.

Thesis.

Factors affecting the radiation dose to the respiratory tract of uranium miners were investigated. These included atmospheric constitution, deposition of radioactivity in the respiratory tract, and physiological translocation. Several aspects of the uranium mine atmosphere were considered, such as radon and radon daughter activity concentrations, physical form and activity-size distribution of the radon daughters, relative humidity, and air temperature. Activity concentrations were found to be extremely variable, however, the remaining atmospheric factors were reasonably stable. Less than ten % of the radon daughters were unattached. The attached fraction could apparently be represented by a mean diffusion coefficient of 1.3×10^{-5} cm^2/sec or an aerodynamic size of 0.067 microns. This diffusion coefficient was not significantly affected by the presence of atmospheric particles produced during normal mining operations. Total and regional deposition percentages were determined experimentally as well as theoretically. Percent total deposition values for individual radon daughters were 50, 45, and 41 for radium-A, radium-B, and radium-C, respectively, for an average respiration rate of 18 min^{-1} and an average tidal volume of 1.2 liters. The influence of respiration rate and tidal volume upon total deposition was examined. Regional deposition fractions for the nasal cavity, tracheobronchial, and pulmonary regions were 22, 15, 63% of the total deposited activity, respectively, for nose-breathing. Physiological translocation of respiratory deposited activity was investigated for various regions of the respiratory system. Results indicated that ciliary translocation was of negligible importance in the dosimetry of inhaled radon daughters. Radiation dose rates to the respiratory epithelium of uranium miners were evaluated by in vivo γ-ray counting techniques. The calculated dose per working level month (WLM) exposure was 0.8 rads/WLM to the basal cells of the tertiary bronchioles (36 micron mucus-tissue depth). The radioactivity was assumed to be uniformly distributed on the epithelial surface lining. The calculated average organ lung dose rate was 0.1 rads/WLM. The calculated dose from radon and radon daughters absorbed in tissue contributed negligibly to the total dose. The measured external γ-ray dose rates were 4.0 rem/yr and less than 1 rem/yr for selected areas in the Schwartzwalder and New Mexico Mines, respectively. (Diss. Abstr.)

7841 MONITORING OF THE AQUATIC ENVIRONMENT OF THE UNITED KINGDOM AND ITS APPLICATION TO HAZARD ASSESSMENT. Mitchell, N. T. (Ministry of Agriculture, Fisheries, and Food, Lowestoft, Eng.). pp 449-62 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The Fisheries Radiobiological Laboratory carries out monitoring of the aquatic environments of all of the major nuclear establishments in the United Kingdom except where drinking water is the primary route by which radioactivity returns to man. The aims of monitoring are discussed by illustration: these are to establish that public exposure is within acceptable limits and consequently that statutory control of waste discharges is adequate. Monitoring programs are based on the critical path approach and a primary factor in their design is the identification of combinations of critical materials and critical radionuclides derived in the first instance from habits and consumption surveys. Indicator materials also feature in programs, particularly in the early stages of operation of a site. The design of several monitoring programs in current use is given to illustrate how application of these principles works out in practice in a wide range of situations. These are grouped into the following categories according to whether public radiation exposure is a significant fraction of the acceptable limit and can be assessed by direct measurement of critical materials; not measurable in critical materials but can be quantitatively estimated by examining indicator materials; or not measurable by any means. Here a limited program may be needed to reassure the public. Recent monitoring data are included and are used to assess the radiation dose received by specific critical groups. It is shown that even for the largest discharge to the sea (from Windscale) contamination is being controlled within acceptable limits. (auth)

7842 CERTAIN ASPECTS OF ROUTINE AND EMERGENCY ENVIRONMENTAL MONITORING AT THE CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE. Osipenco, A. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp 417-25 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969). (In French).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

After describing briefly the situation of the Centre d'Etude de l'Energie Nucléaire, Mol, its technical installations, and the methods used in processing wastes before disposal, the principles applied in monitoring the environmental radiation level, the wastes discharged into the atmosphere, and the radioactive pollution of surface waters and drainage basins are given. A description is given of the equipment used (and its sensitivity), of the sampling techniques employed, and of the method for calculating guide-levels for the release of wastes from chimneys as a function of meteorological conditions at the site and in the light of the existence of several release points. The equipment (in particular a directional anemometer) and methods used for studying diffusion in the atmosphere and ways of checking them by means of a fluorescein aerosol are also described. Finally recommendations are given regarding the first measurements that should be carried out after an accident and the establishment of a catalogue of local milk products and dairies for use if it should prove necessary to restrict milk consumption. (auth)

7843 ENVIRONMENTAL MONITORING IN EMERGENCY SITUATIONS. Carr, J. A. (Ministry of Agriculture, Fisheries, and Food, London). pp 609-19 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Pre-planning invokes assumptions about the composition, magnitude and duration of an accidental release. Within limits there can be a greater flexibility in the plan in respect of the magnitude and duration than in respect of the composition. Field monitoring instruments often only measure the total gamma dose-rate and, even without the complication of an energy dependent response, require interpretation to estimate that part of the instrument response that is attributable to the nuclide of greatest significance. Even in the relatively simple case of a release consisting entirely of iodine isotopes and ^{132}Te, where the field measurement is made with a single gated instrument, contributions from other iodine isotopes to the ^{131}I channel are significant especially at early times. There is thus a great necessity for the composition of the release to be determined as soon as possible. In the case of measurements of the inhalation hazard for a "volatile" fission product release, where time is more pressing than in the agricultural case, a three-channelled spectrometer is used both to determine the ^{131}I concentration and to provide an indication of the fraction of the total activity that this represents. (auth)

7844 A PROGRAM OF ENVIRONMENTAL CONTROL FOLLOWING AN ACCIDENTAL RELEASE OF RADIOACTIVITY TO THE ENVIRONMENT. Kamath, P. R.; Bhat, I. S. (Bhabha Atomic Research Centre, Bombay). pp 621-32 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

In most nuclear installations emergency releases have been postulated to evolve emergency procedures and set the monitoring and control machinery in action following the declaration of an emergency. Various kinds and orders of accidents have been visualized and emergency procedures drawn up to meet the most severe accident occurring under adverse weather conditions. In countries with a high density of population living close to the nuclear installations, or in small heavily populated groups engaged in collective operations like farming, fishing or salt production, emergency conditions may arise even from a moderate accidental release affecting the entire population group. Contamination may reach ground water and affect drinking water supplies, or a heavy unwitting release into surface waters may lead to contamination of agricultural land, affecting their normal modes of operation. These are more realistic and very probable causes for untoward incidents on site, rather than any major damage to the nuclear installation in view of the present engineered safeguards and containments to provide against accidents. The example of the nuclear site and activities at Tarapur, how an emergency may arise, and how it can be controlled under prevailing conditions are discussed. The spread of population in the 30° sectors around the site and sectorwise distribution of population activities are briefly described. Placing these sectors on the weather map, it is possible to identify seasonally significant sectors depending upon wind frequency, occupations of people, agricultural and hay production in a 16-km region round the site. The remedial measures are discussed in the light of acceptable contamination limits under emergency conditions of exposure. The emergency monitoring organization is briefly described. (auth)

7845 PRACTICAL CHOICE OF A MEASURING METHOD FOR AERIAL SURVEYS IN EMERGENCY SITUATIONS. Piesch, E.; Schmitt, A. (Nuclear Research Center, Karlsruhe, Ger.). pp 633-49 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The necessity for quick aerial surveillance after an accidental release of radioactive material is generally acknowledged. The measuring equipment used for this purpose should be able to detect surface contaminations of ^{131}I as low as 0.4 $\mu Ci/m^2$. Until now portable survey meters and scintillation detectors of various sizes have been used. However, it is difficult to compare the published results because the low detection limit for ^{131}I contamination depends on the kind and size of the detector, the measuring methods used, the composition and distribution of the fission products deposited, a knowledge of the background and its local variations, and the influences of the actual flight conditions. Starting from a background survey with a helicopter and from calibration measurements on a meteorological tower with ^{131}I and ^{137}Cs point sources, the sensitivity to surface contamination has been evaluated for an energy-compensated G-M dose ratemeter and a scintillation detector. The lower detection limit and the relative merits of measuring dose-rate, gross counts or the ^{131}I peak are discussed for various compositions of fission products and actual flight conditions. (auth)

7846 THE UNITED KINGDOM APPROACH TO ENVIRONMENTAL MONITORING IN RELATION TO THE DISCHARGE OF RADIOACTIVE WASTES. Neal, W. T. L. (Ministry of Agriculture, Fisheries, and Food, London). pp 345-56 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Environmental monitoring is only part of the general system used to control and minimize any radiation exposure of the public as a result of the use of radioactive materials or of the generation of nuclear energy. The system of control is outlined and the part played by environmental monitoring is emphasized. Supervision of the dispersal of airborne radioactive wastes to the atmosphere is exercised by a system of inspection and environmental monitoring that is designed to ensure that authorized limits are complied with. On many premises where radioactive materials are used the amounts employed are small and there is little possibility of the release of sufficient radioactive material to the atmosphere to cause a public health problem. Even on premises where large amounts of radioactive materials are held, amounts of activity released to the atmosphere are small, although in these cases the potential release resulting from the maloperation or malfunctioning of plant can be of considerable public health significance. The environmental monitoring programs in use and proposed in the United Kingdom reflect this situation. Attention is drawn in the paper to the inability of any environmental monitoring program to be used as an early warning system for accidental releases of radioactivity. The paper discusses the limitations of environmental monitoring programs and the need to develop economic surveillance systems. Associated problems related to the disposal of solid wastes and discharges to sewers are also mentioned. (auth)

7847 AN HISTORIC REVIEW OF LOCAL MONITORING FOR THE CONTAMINATION OF LAND THROUGH DISPOSAL TO THE ATMOSPHERE. Neal, W. T. L. (Ministry of Agriculture, Fisheries, and Food, London). pp 339-44 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The objectives and purposes of environmental monitoring over the past 20 yr are reviewed. A comparison is made of current recommendations with practice and the conclusion is reached that environmental monitoring programs in connection with airborne discharges are excessive. Some suggestions are made on future developments in this area. (auth)

7848 AQUATIC MONITORING PROGRAM. Preston, A. (Ministry of Agriculture, Fisheries, and Food, Lowestoft, Eng.). pp 309-24 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Since the previous FAO/WHO/IAEA seminar at Scheveningen there have been several publications at an international level that relate either specifically to the assessment of aquatic situations or that are applicable to the problems arising in these environments. Contemporary monitoring programs, that are largeiy concerned with the assessment of contamination from waste disposal operations, may be related to two basic methods of hazard assessment, i.e., the specific activity approach or the critical pathway approach, and the possible consequences of these two approaches for monitoring programs are examined in this paper. A third type of approach to monitoring in aquatic situations, that might be termed the point of discharge philosophy, is gaining support and this is also discussed. The types of monitoring programs, their aims, and their significant results are presented. (auth)

7849 RECENT GUIDELINES FOR DEVELOPING ENVIRONMENTAL MONITORING PROGRAMS (LAND AND WATER) NEAR NUCLEAR INSTALLATIONS. Kamath, P. R. (Bhabha Atomic Research Centre, Bombay). pp 295-308 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Radioactivity monitoring of environmental media near nuclear installations is essential to determine radioactivity levels present and to obtain information required for the assessment and control of population exposure. The direct radiation exposure outside the exclusion area or the site boundary may not be significant in normal operations because of built-in safeguards and safe siting criteria. Contamination of the shoreline through accumulation in sediments and transport is a gradual process and calls for vigilance. The emphasis on environmental investigation shifts therefore to exposures resulting from the consumption of land and aquatic produce containing released radionuclides in one form or other. Radioactivity uptake in environmental items is caused through releases in public water supplies used for domestic purposes, fishing, or agriculture and from depositions on fields and pastures. The exposure dose to the population is evaluated from a measure of specific radionuclides in the daily diet (including drinking water), discriminatory factors in uptake, physiological norms, isotopic dilutions offered by the trace elements present, and the chemical nature and combination in which the tracer exists in dietary items. The development of a realistic and economic survey program depends upon the type of nuclear installation, geographic location (inland or coastal), wastes inventory and disposal practice, nature and utilization of land and water bodies, and population distribution, habits, and activity in the near and outlying areas. Economy and speed are realized through a minimal surveillance program by: identifying hot spots and indicators that selectively concentrate specific radionuclides or gross activity; a study of air and water movements; and recognizing the critical food and groups of population. The paper describes how these programs have been carried out in different installations to predict trends and control population exposure. The value of gross activity measurements and some recent advances in environmental monitoring methods are also discussed. (auth)

7850 INVESTIGATION OF THE RADIOACTIVITY OF THE DANUBE. Tasovac, T.; Radosavljevic, R. (Boris Kidric Inst. of Nuclear Sciences, Vinca, Yugoslavia). pp 427-33 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

As part of the program for investigating the radioactivity content of the Danube and the distribution of radioactive nuclides in different components, systematic measurements of the total β activity of water, suspended materials, bottom sediments, plankton, bottom biota, algae, and fish, as well as gamma-spectrometric measurements, were made. Some results are presented. (auth)

7851 SCPRI EMERGENCY KIT FOR USE IN THE EVENT OF A NUCLEAR ACCIDENT. Ervet, P.; Moroni, J. P.; Pellerin, P. (Service Central de Protection Contres les Rayonnements Ionisants, Le Vesinet, France). pp 559-65 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In French).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

In the event of a nuclear accident necessitating implementation of the ORSEC radiation protection plan, the Central Service for Protection against Ionizing Radiations, in conjunction with the National Civil Defence Service, has adopted the necessary measures for rapid evaluation of possible contamination as promptly as possible. With this aim in mind the Service has prepared emergency kits, which are permanently stored at airfields in the Paris region. These can be carried by aircraft together with two engineers from the Service, thereby enabling them to reach the site of the incident with the specialized equipment in a few hours at most. The monitoring and sampling equipment as well as the conditions under which the kit is carried and used are described. The monitoring equipment is basically designed to permit an initial assessment of the situation, to furnish local authorities with data on which to base decisions for the safety of the population, and to determine any additional measures that need to be adopted. (auth)

7852 A CASE OF INSOLUBLE NATURAL-URANIUM EXPOSURE. A TWO-YEAR FOLLOW-UP STUDY. Ronen, M. (Israel Atomic Energy Commission, Negev). pp 451-7 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The urine analysis and lung burden of a laboratory worker who was accidentally exposed to uranium dust is reported. Urine collections were done daily, and for some time aliquots were also examined three times a day. After several months of this procedure the urine was examined on three consecutive days each month. The amount of uranium found varied from 60 to 4000 μg/litre. Direct lung measurements were also done using a whole-body counter. The estimated lung burden according to this method was: 210 μg/litre five months after the exposure; 110 μg/litre eight months after the exposure; 61 μg/litre one year after the exposure, and 52 μg/liter two years after the exposure. As the amount of uranium varied between 20 to 4000 μg/litre, no correlation was found between the urine excretion of the uranium and the lung burden. This raises the question whether it is possible to estimate the lung burden of insoluble uranium by urine excretion only. (auth)

7853 USEFUL INFORMATION AND DATA IN THE EVENT OF AN ACCIDENT. Jammet, H. (CEN, Fontenay-aux-Roses, France). pp 385-8 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In French).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

In the event of a radiation accident, it is most important to collect as much physical and medical data as possible in order to establish the correlations likely to exist between them. It is desirable that the problems raised by accidental external exposure and internal radioactive contamination be treated separately. A list of the essential data, physical and medical, which should be collected is presented. The physical information in the event of accidental external exposure relates to the nature, circumstances, and magnitude of exposure and, in the event of internal radioactive contamination, to the nature, circumstances and magnitude of contamination. The medical information in the event of accidental external exposure should comprise diagnostic, therapeutic, and prognostic data; in the event of radioactive contamination, it should also comprise diagnostic, therapeutic, and prognostic data. It is often possible, on the basis of physical and medical data, to establish correlations between accidental exposures and internal contaminations, the corresponding absorbed doses, and the functional and morphological damage sustained. In numerous cases, however, it is difficult to collect accurate information. The reconstruction of external exposure accidents or the experimental reconstruction of internal contamination can assist in refining incomplete data obtained following an accident. (auth)

7854 PERSONNEL MONITORING OF EXTERNAL EXPOSURES RESULTING FROM RADIATION ACCIDENTS. Spurny, Z. (Nuclear Research Inst., Prague). pp 287-97 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

A brief review of methods and techniques for estimating the doses received from external sources in radiation accidents is presented, with emphasis on research and the development of improved methods. Dosimetry methods such as film badges, ionization chambers, radiophotoluminescence, radiothermoluminescence, conductivity, electronexoemission, track and activation detectors, and individual alarm systems are discussed. Comparisons are made between their operational characteristics and the overall efficiency. The mechanical model for expressing Rems in connection with the present-day practice of personnel monitoring of external exposures is discussed. The necessary precision of dosimeters, the estimation of the exposure dose from dosimeter readings, the estimation of absorbed dose from exposure dose; dose-equivalent transformations are analyzed. All necessary aspects of such transformations are discussed. The role of the time estimation of the dose received and recovered during protracted accidental exposures are considered. (auth)

7855 THE MOBILE LABORATORY FOR HUMAN SPECTROMETRY OF THE SCPRI. Pellerin, P.; Moroni, J. P. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet, France). pp 317-25 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In French).

From Symposium on the Handlin g of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

In the event of a nuclear accident in France involving the risk of activation or radioactive contamination of a widespread population, the Central Service for Protection Against Ionizing Radiations would immediately send out its mobile laboratory, which from 1969 onwards will be in routine use for personnel monitoring. The laboratory is a 33-ton trailer-type vehicle carrying four fully-shielded whole-body counters, each fitted with two 8×4-inch NaI(Tl) crystals, the pulses being analyzed by two 400-channel spectrometers. The layouts of the unit and the electronic safety devices installed make it possible to carry out personnel monitoring very rapidly, using only two trained technicians. Under conditions such as may arise at the time of a nuclear accident, as many as several hundred persons a day could be counted. (auth)

7856 BIOLOGICAL DOSIMETRY WITH PARTICULAR REFERENCE TO CHROMOSOME ABERRATION ANALYSIS. A REVIEW OF METHODS. Dolphin, G. W. (United Kingdom Atomic Energy Authority, Harwell, Eng.). pp 215-24 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

Following accidental over-exposure, the radiation dose to the body or body organs is required for planning therapeutic procedures, for relating the observed early and late biological effects, and for determining future employment in radiation work of the exposed person. Studies of the changes in cell concentration in the peripheral blood, excretion of metabolites, and chromosome aberrations in peripheral blood lymphocytes have been used to estimate radiation dose. At present the studies of chromosome aberrations in peripheral blood lymphocytes appear to be the most readily quantifiable method of biological dosimetry available. The problems associated with the use of this method in estimating whole-body or partial-body radiation dose are discussed. These problems include the establishment of an in vitro calibration of chromosome aberration yields for given neutron and gamma ray doses, interpretation of chromosome aberration yields in terms of effective dose following partial-body irradiation, and the statistical accuracy of this method of dosimetry. (auth)

7857 RESPECTIVE ROLES OF PHYSICAL AND OF BIOLOGICAL DOSIMETRY IN THE EVENT OF AN ACCIDENTAL OVEREXPOSURE. Jammet, H. (CEN, Fontenay-aux-Roses, France). pp 327-39 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In French).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

In radiation accidents, one of the most important fields to be considered is that of dosimetry. In view of the difficulty of ob-

taining suitable results, all available methods should be used and their respective merits analyzed. These methods can be classified under two main headings, physical dosimetry and biological dosimetry. Methods that can be used in the event of an accidental overexposure are discussed. Physical dosimetry comprises physical measurements and the evaluation of absorbed doses. Physical measurements include the results of collective and personal dosimetry, as well as those which may be obtained by a reconstruction of the accident. A somewhat complicated interpretation of the physical measurement data yields an evaluation of the total, local, and integral absorbed doses. Biological dosimetry can play an important part in the evaluation of whole-body or partial exposures. The evaluation of whole-body exposures is based on clinical development, neurological syndrome, hematological syndrome, and biochemical and chromosomal changes. The evaluation of partial exposure is of interest in the case of cutaneous, ocular, and gonadal radiolesions. The respective roles of physical and of biological dosimetry are illustrated by an example, that involved an accident at the Centre d'Étude de l'Énergie Nucléaire at Mol in December 1965. In physical dosimetry it was necessary to evaluate a heterogeneous whole-body exposure caused by a mixed flux of photons and neutrons and a very high partial exposure affecting a limb. The accident was reconstructed so that the dosimetric data could be determined with accuracy. In biological dosimetry, it was found that for the evaluation of whole-body exposure it was most desirable to pay attention to clinical development, neurological and hematological syndromes, and biochemical and chromosomal changes. The evaluation of partial body exposure was based on cutaneous lesions. (auth)

7858 SUGGESTED METHODS FOR ASSESSMENT OF ACCIDENTAL EXTERNAL EXPOSURE AND INTERNAL CONTAMINATION OF WORKERS AND THEIR MEDICAL MANAGEMENT. Mahmoud, K. A.; Morsy, Samira M.; Hanna, I. R. A.; Hafez, M. B.; Mohamed, H. O.; Jahns, E.; Saied, F. I. A. (Atomic Energy Establishment, Cario). pp 247-58 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

Certain assumptions are given for the amount of fission products released from a research reactor after the occurrence of an accident. The size and location of radioactive cloud are assumed, and the corresponding external and internal exposures of workers are computed. A method is suggested for assessment of accidental external radiation dose based on experimental studies performed on the changes of quenching effect of plasma or sera as a result of whole-body gamma-radiation ranging from 25 to 200 rems. For assessment of accidentally internally-incorporated gamma emitters, the standard chair whole-body counter technique was found to detect reliably $^{1}/_{100}$ of the maximum permissible body burden within eight minutes. It was also suggested that a separation method based on the use of absorption phenomena observed for Sephadex (gel resin) can be applied for quick determination of gross alpha activity in urine. For treatment of workers accidentally exposed to radiation doses of a lethal or sublethal nature, bone-marrow transplantation therapy and blood component therapy in sterile rooms is discussed in the light of experience gained from treatment of leukemia with intensive chemotherapy. (auth)

7859 WHOLE-BODY COUNTER AND BIOASSAY RESULTS AFTER AN ACUTE ^{124}Sb EXPOSURE. Rose, E.; Jacobs, H. (Nuclear Research Inst., Juelich, Ger.). pp 269-80 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

A case of laboratory contamination occurred in a research building in the Nuclear Research Establishment, Jülich. Before the contamination was detected, one individual working in the room inhaled an insoluble, but possibly transportable, dusty material containing ^{124}Sb. The amount of the total intake could not be determined exactly because of the superposition of incorporation and skin contamination within the first 24 hours. From extrapolation values during the following days, an evaluation was made to the effect that the total amount of incorporation must have been about 35 μCi. Metabolic investigations were done by in vivo counting and analysis of urine and feces. In vivo counting and excreta analysis were in good agreement. The major part of the original activity (about 95%) was excreted within the first four days through the gastro-intestinal tract. Dose calculations led to the conclusion that the integrated dose did not exceed the maximum permissible values. For the G.I. we calculated not more than 5 rems, for the head 2 rems and for the total body 0.15 rem. In some soft tissue, e.g., in the nasopharynx and the G.I., there might have been some higher dose, but because of the lack of special equipment there was no possibility of more exact assay. In the first weeks after the incident the effective half-life was found to be about 30 days. Literature values for $T_{eff.}$ range from 23 to 38 days. In the last months the effective half-life was about 60 days. This corresponds to the physical half-life of 60 days. The decorporation of the body in the first weeks was caused by transportable material in the tissue, the decorporation in the last months was caused by non-transportable material deposited in the lungs. (auth)

7860 MONITORING OF THE ENVIRONMENT IN THE EVENT OF RADIATION ACCIDENTS. Korsakov, Yu. D.; Poplyko, I. Ya.; Ternovskii, I. A. (Inst. of Atomic Energy, Moscow). pp 281-5 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

Following contamination of the ground with long-lived fission products, monitoring is effected in two stages: during the first five hours after an accident the radiation situation is assessed by means of calculations based on the results of gamma dose rate measurements; during the subsequent two days a detailed study is made of the radiation situation and a program for further monitoring is worked out from the data obtained. Values are given for parameters which express the contamination of components of the environment as a function of the density of the radiation contamination of the ground. These parameters, determined on experimental sections of the ground, are used for the fast assessment of the radiation situation during the first stage of the monitoring. (auth)

7861 APPLICATION OF RADIOTHERMOLUMINESCENCE TO AREA DOSIMETRY IN THE EVENT OF A NUCLEAR ACCIDENT COVERING A WIDE AREA. Partal, G.; Marchal, P.; Francois, H.; Pradel, J. (CEN, Fontenay-aux-Roses, France). pp 299-315 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In French).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

Although numerous systems have been studied and developed for providing γ dosimetry at nuclear facilities in the event of an accident, very few of them are really satisfactory as regards their physical characteristics or the practical conditions under which they are applied. Most of them are not completely insensitive to neutrons and the response has to be corrected if the dose is to be evaluated with accuracy. This presupposes that the incident neutron spectrum is known, since the corrections that have to be made vary with the neutron energy. In most cases the systems require fairly large financial investment and some of them, have to be regurarly renewed such as photographic dosimeters. The possibility of using thermoluminescent materials to make an inexpensive dosimeter possessing low neutron sensitivity was considered. Corundum, which is manufactured industrially and is available on the market at low cost was tested. The radiothermoluminescent characteristics of corundum were compared to those of commercial lithium fluoride. The practical conditions under which this material can be used were evaluated. It was concluded that it can be used both for area dosimetry at nuclear facilities where there is potential risk of strong radiation and for problems involving civil defence. (auth)

7862 METHODS OF PHYSICAL MONITORING FOR RADIATION ACCIDENTS WITH SPECIAL REFERENCE TO ALARM AND EARLY WARNING SYSTEMS. Krishnamoorthy, P. N. (Bhabha Atomic Research Centre, Trombay, India). pp 201-13 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The current status of developments in the field of dosimetric techniques appropriate to radiation accident situations is reviewed. Attention is drawn to the extremely important role played by alarm and early warning systems. The characteristics of such systems are discussed briefly. The areas of inadequacy in techniques used at present are discussed. Particular attention is drawn to the intermediate energy neutron range where satisfactory techniques for dosimetry are still to be developed. The importance of both national and international intercomparisons of the various radiation accident dosimetry systems in use is stressed. (auth)

7863 PROMPT ASSESSMENTS AND MITIGATORY ACTION AFTER ACCIDENTAL INTAKE OF PLUTONIUM. Jech, J. J.; Heid, K. R.; Larson, H. V. (Battelle-Northwest, Richland, Wash.). pp 77-93 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

During the 24 years in which the Hanford plant has operated, there have been some 1400 incidents involving potential internal deposition of plutonium. About 20% of these resulted in some degree of deposition with 17 exceeding 50% of the maximum permissible body burden (MPBB) of 0.04 μCi with bone as the organ of reference. In 46,000 man years of plutonium work, only six people exceeded the MPBB and all are still employed at Hanford, although they are restricted from further work with plutonium. The experience gained, however, indicates that accidental exposure to plutonium may be expected regardless of the precautions observed. As a result of the experience gained, procedures were developed for initiating prompt mitigatory action following incidents involving plutonium. These procedures included actions directed toward minimizing internal deposition and estimating the severity of intake. The new ICRP lung model concepts were used to evaluate depositions from fecal and in vivo examination data. The results from these evaluations and evaluations based on urinary excretion data were compared to early survey data for possible correlations. Correlations between nasal smear activity and depositions were found for inhalation cases. These correlations, along with in vivo examination data were expanded to develop guides for making initial estimates of intake. Guides were also developed for estimating depositions based on the residual activity in wounds for soluble plutonium injection cases. Comparisons of the deposition estimates obtained using these guides to evaluations from fecal, in vivo, and urine data indicate that these guides are reasonable for most Hanford cases. (auth)

Radiation Protection

Refer also to abstracts 7826, 7828, 7873, and 7907.

7864 (STI/PUB-206) SAFETY CONSIDERATIONS IN THE USE OF PORTS AND APPROACHES BY NUCLEAR MERCHANT SHIPS. Safety Series No. 27. (International Atomic Energy Agency, Vienna (Austria)). Oct 1968. 20p. IAEA $1.00.

This report, published on behalf of the IAEA and the Inter-Governmental Maritime Consultative Organization, of a panel of experts convened by the IAEA contains the outcome of the last two meetings held in Vienna on 9 to 13 May 1966 and 18 to 22 March 1968, at which representatives of four international organizations were also present. The purpose of this publication is to provide guidance to Governments and Port Authorities on the procedures and precautionary measures that may be employed when nuclear merchant ships use ports and approaches. The contents include: purpose and scope; introduction; general factors in the selection of berths; radiological considerations; and practices concerned with the use of ports by nuclear merchant ships. The report contains a bibliography and is available in English and French. (auth)

7865 MINIMIZING RADIATION EXPOSURE OF PATIENTS AND PERSONNEL. Winkler, Norlin T. (Mayo Clinic, Rochester, Minn.). Radiol. Technol.; 41: 142-9(Nov 1969).

Methods for minimizing exposure of patients and medical technologists are presented. Topics discussed are screen-film combination, film processing techniques, exposure factors, target-film distance, collimation, added filtration, protective shields and clothing, and grid ratio. It is pointed out that exposure reduction can best be accomplished as a cooperative venture by the technologist and the radiologist to be certain that required film quality is not compromised when roentgen exposure is minimized. (H.L.W.)

7866 PERSONAL PROTECTION IN THE EVENT OF RADIATION ACCIDENTS. Gorodinskii, S. M.; Rokhlin, M. I.; Shcherbakov, V. L. (Inst. of Biophysics, Moscow). pp 363-81 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In Russian).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The special demands made on protective devices are discussed in the light of the specific nature of radiation accident control work. The results are given of tests on volunteers to establish the penetration of ^{131}I through respiratory organs and undamaged skin, from which the hazard of iodine penetration through the skin was evaluated and the specifications for devices to protect personnel against the vaporous compounds of radioiodine were determined. A procedure for evaluating the protective efficiencies of various personal protection facilities directly from radioactive substances with the use of a specially designed chamber is described, and the results obtained are presented. A brief description is given of the personal protection devices which are intended for use in the event of radiation accidents (LG-type pressure suits, IKAP-type insulating outfits with independent air supply, LIZ-KS-type suits for gas and electric welding, and gas masks). (auth)

Safety Procedures

Refer also to abstracts 7474, 7780, 7840, 7852, 7866, 7940, 7941, 7943, 7944, and 8013.

7867 (STI/PUB-169) MANUAL ON SAFETY ASPECTS OF THE DESIGN AND EQUIPMENT OF HOT LABORATORIES. Safety Series No. 30. (International Atomic Energy Agency, Vienna (Austria)). Mar 1969. 102p. IAEA $3.00.

The purpose of this manual, prepared by the IAEA with the help of three consultants from three countries, is to help those persons, particularly in the developing countries, who plan to design and construct a new hot laboratory or modify an existing one. The topics discussed include: the arrangement of working areas inside the building; enclosures; handling and viewing systems; transfer and transport systems; ventilation system; radioactive waste disposal systems; and personnel protection. A list of references is included in the manual, which is available in English or French. (E.R.B.)

7868 (STI/PUB-201) MEDICAL SUPERVISION OF RADIATION WORKERS. Safety Series No. 25. (International Atomic Energy Agency, Vienna (Austria)). Jun 1968. 118p. IAEA $3.50.

This manual, which is a revised edition of Safety Series No. 3, Safe Handling of Radioisotopes: Medical Addendum, was prepared at the request of the IAEA, ILO, and WHO by Dr. H. Jammet, (Saclay Nuclear Research Center, France) and Dr. F. Hercik (Institute of Biophysics, Czechoslovak Academy of Sciences, Brno), who had collaborated in writing the original edition. The manual provides information necessary for implementing the controls in the main manual (Safety Series No. 1) and an introduction to technical problems of radiological protection. The contents include: introduction; basic concepts; radiological hazards; radiation protection standards; and health supervision. The manual contains references and a bibliography, and is available in both English and French. (auth)

7869 (STI-PUB-229) HANDLING OF RADIATION ACCIDENTS. Proceedings Series. Proceedings of a Symposium Held in Vienna, 19-23 May 1969. (International Atomic Energy Agency, Vienna (Austria)). Oct 1969. 722p. (In several languages). (CONF-690509). IAEA: $20.00.

Separate abstracts were prepared for 54 papers that discuss various aspects of radiation accidents. (C.H.)

For abstracts of individual papers see: 7624, 7641, 7661, 7662, 7834, 7851-7863, 7866, 7882-7909, 7940-7944, 8012, and 8013.

7870 ACCIDENTS OF NUCLEAR POWER PLANTS AND THE HAZARD TO THE PUBLIC. Behounek, Frantisek (Nuclear Research Inst., Prague). Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove; 11: 415-24(1968).

Accidents at nuclear power plants are casually connected with the release of radioactive gases and aerosols. At present the direct breathing of ^{131}I from the radioactive plume is considered as the greatest health risk. It is assumed that its accumulation in the human thyroid gland can induce thyroid carcinomas. An estimate of population doses is encumbered with considerable uncertainty whether they are computed or directly measured. The main role in the protection of the population lies with the safeguards reducing, to a minimum, the possibility of an accident and also the release of radioactivity in the case of accident. The distance from the source of the accident and the height of the stack for the gas outlet of the reactor play secondary roles. (auth)

7871 CHROMOSOMAL ANOMALIES IN INDIVIDUALS WORKING IN CONDITIONS OF RADIATION. Zivkov, St.; Kirov, K.; Donev, Iv.; Bulanov, Iv. Suvrem. Med.; 19: 445-52(1968). (In Russian).

Structural and numerical chromosomal anomalies that affect from 6 to 34 percent of the tested cases are established in 30 individuals who work under conditions of ionizing radiation and are exposed to an average year dose from 17 to 682 mRads. The results are evidence that small doses of ionizing radiation are able to produce chromosomal changes in the somatic cells of man. The cytogenetic method can be used for detection of radiation affections in persons working in conditions of ionizing radiation. (Abstr. Bulg. Sci. Lit.)

7872 RISK EVALUATION IN RELATION TO THE PROTECTION OF THE PUBLIC IN THE EVENT OF ACCIDENTS AT NUCLEAR INSTALLATIONS. Dolphin, G. W.; Marley, W. G. (United Kingdom Atomic Energy Authority, Harwell, Eng.). pp

241-54 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Evaluation of the late biological effects in populations surrounding a nuclear installation following an accidental release of radionuclides is of value for the assessment of the relative merits of reactor sites and reactor systems, and for planning countermeasures in the event of an actual release. A brief review is given of data available on the escape of fission products in reactor accidents, based on actual experience and also from experimental work with oxide and carbide fuels. Although iodine may be the predominant source of irradiation of body tissue for many types of reactor, the paper emphasizes that circumstances may greatly affect the proportion of the various nuclides; the use of sodium coolant in particular may considerably reduce the escape of radioiodine, thus greatly increasing the importance of nuclides which irradiate the whole body. A review is then given of the most recently available data on the incidence of leukaemia, thyroid cancer, lung cancer, and other malignant neoplasms following irradiation. From consideration of the risk coefficients derived from these data recommended values are given for use in calculations of the expected late biological effects in irradiated populations. The recommended risk coefficients are 20, 80 and 10 per 10^6 man-rads for leukemia, all other malignant neoplasms and individual organs, respectively. No data are available for making a direct estimate of the risk coefficient for thyroid cancer following ^{131}I irradiation but reasons are given for recommending values of 30 and 10 per 10^6 man-rads for infants and adults respectively. It is noted that only a small number of radiation-induced thyroid cancers have caused death and for purposes of calculation the fraction is taken to be 10%. It is recommended that the risk coefficients given in this paper should not be used at dose levels below 10 rads. (auth)

7873 RISK EVALUATION FOR PROTECTION OF THE PUBLIC IN THE EVENT OF ACCIDENTS. Biese, A. F. W. (Public Health Authority, Duesseldorf). pp 231-40 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The risks to the public in the event of an off-site accident vary largely with the kind and extent of radiation to which the public will be exposed. The various risks are discussed and their order of magnitude is indicated and compared with other risks with which the public is accustomed to live. (auth)

7874 PLANNING FOR THE HANDLING OF RADIATION ACCIDENTS INVOLVING CONTAMINATION OF THE ENVIRONMENT. Biese, A. F. W. (Public Health Authority, Duesseldorf). pp 581-6 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Referring to a special case in the Federal Republic of Germany, some outlines of a real plan to cover off-site accidents are given, mainly from the public authorities point of view. (auth)

7875 EMERGENCY PLANNING BY PUBLIC HEALTH AGENCIES IN THE UNITED STATES OF AMERICA. Weaver, C. L.; Eure, J. A.; Martin, J. E. (Bureau of Radiological Health, Washington, D. C.). pp 597-608 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Initiation of actions to protect the public from potential consequences of radiological incidents within the USA can best be carried out under the authority of the respective States. The States' unique authority to implement protective actions in the uncontrolled environment when the public health and safety are jeopardized requires a great deal of effort in planning to meet these responsibilities in this area. Experience gained by the U. S. Public Health Service in assisting several States in developing such plans for transportation accidents, heat sources, human injury, and releases from nuclear power stations is discussed. Emphasis is placed on problem areas encountered such as delineation of authority and responsibility to act, notification criteria, monitoring techniques, protective action guides, evacuation of populated areas and relative risks. Examples of these problems and experience gained in solving them are given, gaps in current practice are discussed and possible solutions for certain problems are suggested. The material presented is based on several years experience by the U. S. Public Health Service in carrying out its traditional responsibility of assisting States with radiological health programs. Recent assistance to many States has emphasized developing emergency plans for nuclear reactors because of the rapid growth of nuclear power in the United States. Information obtained in working with these States has been valuable in developing plans for others, showing areas where additional study is needed, and identifying resources necessary at the Federal level. In this context, resources available from the interagency radiological assistance plan participants to supplement those of State health agencies are discussed. (auth)

7876 THE RELATIONSHIPS BETWEEN SITING POLICY, DESIGN, AND EMERGENCY ACTIONS IN THE UNITED KINGDOM POWER PROGRAMME. Dale, G. C. (Central Electricity Generating Board, London). pp 561-9 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The earlier siting policies show clearly the influence of the atomic weapons that preceded the peaceful use of nuclear fission. Accidental reactor excursions were described in terms of power equivalents of numbers of fissions. The inventory of isotopes was later shown to be of major importance and the hazards of radioisotopes of iodine recognized as controlling. It should be realized that in a densely populated island such as the British Isles there is no site sufficiently remote from people to allow an ultimate release of radioactivity to take place without some risk to life. Designers worked towards providing containment systems so reliable that maximum credible accidents could be postulated and sites chosen accordingly. Emergency schemes were aimed at keeping doses to inhabitants in the vicinity of power reactors from maximum credible accidents down to recommended levels. With increasing sophistication of fault analysis, probabilities of fission product escape from the containment were calculated and in recent years the probability approach was refined to quantify definitions of incredibility. As urban siting became more urgently required, the effect of the recommended doses upon large numbers of people received a great deal of attention and the concept of individual risk has evolved. Emergency schemes now being planned take cognizance of the reduced risks that increased confidence in the safety of present reactor designs justifies. (auth)

7877 MEASURES FOR REDUCING CONTAMINATION AND MEDICAL REMEDIES. Pellerin, P. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet, France). pp 651-6 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969). (In French).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The emergency situations that can give rise to radioactive contamination are described, and their frequency and relative importance assessed. The present encouraging situation should not be allowed to obscure the problems that are certain to result from the increasingly widespread use of radioactive sources. The means available for controlling internal radioactive contamination (e.g., iodine and stable calcium, complexing agents, artificial kidneys) are neither unlimited nor absolutely effective. It should always be borne in mind that the treatment of vital injuries takes precedence over decontamination. (auth)

7878 REVIEW OF SOME PAST EMERGENCIES WITH CONSIDERATION OF THEIR PUBLIC HEALTH IMPLICATIONS. Howells, H. (United Kingdom Atomic Energy Authority, Sellafield, Eng.). pp 521-7 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Consideration is given to the categories of accidents that have, or might have had, the potential to cause public health problems due to the spread of radioactive contamination. These are categorized as reactor accidents, criticality accidents, and contamination caused by accidents arising in the transportation of radioactive materials. A brief outline is provided of three such accidents. General conclusions are drawn from these events to provide a basis for dealing with such events in the future. (auth)

7879 MEASURES TO DETERMINE THE RISK TO WHICH A POPULATION CAN BE SUBJECTED AS A RESULT OF A NU-

CLEAR ACCIDENT GENERATING RADIOACTIVE AEROSOLS. Iranzo, E.; Ramos, E. (Junta de Energia Nuclear, Madrid). pp 529-40 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969). (In Spanish).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The safety measures taken to protect people living in an area where a radioactive aerosol has been produced are described. The reasons to decide against the evacuation of the area and the way the personnel operated or co-operated to check the existence of internal contamination as a consequence of the inhalation of the generated aerosol are also given. A résumé of the techniques used to determine the burden in the lungs, the amount eliminated with the urine, and the results from 100 persons selected for this purpose are also given. (auth)

7880 SITING FACTORS AND THEIR BEARING ON EMERGENCY SITUATIONS. Lafontaine, A. (Institut d'Hygiene et d'Epidemiologie, Brussels). pp 541-7 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969). (In French).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The main siting considerations that play a part in the safety of a facility are biological, hydrological, climatic and meteorological, demographic, geographical, and ecological factors as well as the possible presence of other facilities on the same site. These can have a considerable bearing on the cost of the facility owing to their effect on safety measures during normal operation and under exceptional circumstances. In the latter case, they also have a bearing on the emergency measures that may become necessary in view of the special nature of the radiation hazard. In extreme cases these measures may even involve abandoning the site. Generally speaking, siting has not been given enough attention thus far, too often having been subordinated to economic and industrial factors. A further justification for stressing the matter of siting is the fact that evaluation of safety is often difficult at the start when important design details have not yet been given their final form. The conditions that should be given maximum consideration to ensure the most judicious siting are discussed. (auth)

7881 MANY HOSPITALS FALL SHORT IN OCCUPATIONAL HEALTH PROGRAMS, SAMPLE SURVEY INDICATES. Larsen, Lee, B.; Seligman, Ellis J. Hospitals; 43: 75-9(16 May 1969).

The findings of a limited survey of occupational health services provided hospital employees are presented that attempt to point out certain areas where special health hazards exist. Although hospitals are among the organizations best equipped to conduct occupational health programs for employees, hospital management is not fulfilling this obligation. In the hospitals surveyed, managers frequently were not aware of potential health hazards to employees under their jurisdiction. Provisions for employee health and safety in most hospitals surveyed was handled on an incidental basis rather than as part of an organized occupational health program. Usually, control measures for health hazards had been instituted to comply with state or federal regulations. Since the hospital environment affords opportunities for exposure to a wide variety of harmful agents, including radiation, hospitals should protect their employees with a carefully organized occupational health program. State and local health agencies should provide industrial hygiene assistance to aid hospitals with special problems and should include hospitals in routine occupational health surveys. (C.H.)

7882 CHARACTERISTICS OF RADIATION EXPOSURE ACCIDENTS. Biles, M. B. (Atomic Energy Commission, Washington, D. C.). pp 3-18 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

There are various approaches to the classification of radiation accidents. For purposes of this paper it is considered most appropriate to characterize accidents on the basis of the extensive atomic energy experience in the United States. Available accident statistics result from many years of accident reporting and investigation in government and private atomic energy programs and from limited experience with the medical use of isotopes. Additional data are available from over 10 years experience with the USAEC Radiological Assistance Program. Statistics have been assembled to provide interesting and useful characterizations of radiation accidents involving fatalities, lost time injuries, and reportable radiation exposures on the basis of the following parameters: type of operation, type of facility, type of incident, type of work activity, and type of radiation exposure. Analyses are presented in the form of charts and tables. Summaries are drawn based on the several characterizations. Studies of characteristics of radiation accidents are useful in prevention of accidents and preparing for care of victims and should be encouraged on a national and international basis. (auth)

7883 ORGANIZATION OF AID IN EMERGENCY SITUATIONS. Vorob'ev, A. I.; Petushkov, V. N.; Shakhmatov, V. I.; (and others) (Inst. of Biophysics, Moscow). pp 587-93 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In Russian).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The concentration of patients in a single highly-specialized center makes it possible to obtain comparable data from the study of various cases of radiation injury. A specialized medical establishment should be able to undertake the necessary work in order to develop a rational course of treatment, to determine the dose received, by both physical methods and biological methods (especially those which quantitatively give the best correlation with physical tests, i.e., determination of the number and form of chromosome breakages in the bone marrow and the peripheral lymphocyte culture), and to maintain cytological, karyological, and immunological observation to ascertain whether transplanted bone marrow has taken or been rejected. Under normal circumstances (where there is no accident) the center should perform the function of a hematological and surgical clinic. A singular, though not fully adequate model for acute injury is toxic agranulocytosis, which occurs when patients with tumors of the blood system are treated with large doses of cytostatic preparations and with whole-body irradiation. This model is used for day-to-day studies aimed at the proper evaluation and treatment of accident cases. Analysis of damage to chromosomes in bone marrow cells during local γ therapy for patients with a variety of tumors and during whole-body irradiation of two persons suffering from acute leucosis have shown that karyological investigation may be an important link in biological dosimetry and may indicate the degree of non-uniformity of the injury; local γ irradiation of the ilium and sternum with 220 rads shows up about 60 per cent of the mitoses with chromosome disturbances (0.005 breaks per cell per R); the same proportion of chromosome aberrations can also be detected following whole-body irradiation at the same dose. Casualties should be brought to the center immediately after the accident and at the same time be given medical attention to alleviate their initial reaction. Those who have been subjected to doses greater than 200 to 300 rads must be placed in special individual cubicles supplied with near-sterile air. Serious cases receive comprehensive therapy from the moment of their arrival as follows: transfusion of 20 to 30,000 million freshly prepared bone marrow cells every five or six days until there are signs that hematopoeisis has begun, antibiotics, gamma globulin, and a special diet. After treatment, patients should be given suitable employment in accordance with their trade or profession. (auth)

7884 THE NUCLEAR EMERGENCY ASSISTANCE TEAM, AN INSTITUTION FOR NUCLEAR EMERGENCY RELIEF. Boldyreff, P.; Kiefer, H.; Krause, H.; Zuehlke, K. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). pp 567-78 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The design of nuclear facilities includes control measures to prevent serious contamination of the environment, even in case of the MCA (maximum credible accident). Although the likelihood of accidents exceeding the expected consequences of the MCA is extremely small, it is deemed reasonable to take general precautions against such accidents. Precautions of this type are customary also in the conventional field, and in this case they are to be implemented in part through the Nuclear Emergency Assistance Team. If the internal safety provisions of a nuclear facility are unable to prevent an impermissible leakage of radioactivity as the result of a major accident there is, at present, no possibility of decisively curbing the spread of activity throughout the environment in the first few hours after the accident. Hence the measures taken by the authorities as a result of the emission and immediately following upon it will have to be restricted to the protection of the population. These include analysis of intensity and pattern of distribution of activity, instructions to seek closed shelters, or prohibition of the consumption of certain foodstuff. It is the purpose of the Nuclear Emergency Assistance Team to bring relief in the phase following the end of the emission. This may comprise the following steps: exact investigation of the external scope of the damage, in particular assessment of the con-

tamination of ground, persons, and material; rapid personnel decontamination; securing and shielding radiation sources; fixing contamination and removing it immediately where this is deemed urgent for reasons of traffic or to keep the drinking water free from contamination; external containment of the source of danger; and support in limiting the damage within the facility. In addition to these tasks of emergency protection, the Nuclear Emergency Assistance Team can take action also in the event of contamination within the facility which have no influence on the environment and where the operator does not have the necessary means to remove the source of contamination. Furthermore, the Nuclear Emergency Assistance Team is also equipped to render assistance in non-nuclear disasters. Details are given of the organization, the available and planned equipment, and of some of the experience gained in action. The Gesellshaft für Kernforschung mbH is prepared also to make the Nuclear Emergency Assistance Team available outside the Federal Republic of Germany, if its assistance is desired. (auth)

7885 MEDICAL PLANNING AND CARE IN RADIATION ACCIDENTS. Biles, M. B.; Doran, W. T. Jr. (Atomic Energy Commission, Washington, D. C.). pp 669-74 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

As part of a broad effort intended to mitigate the consequences of radiation accidents, the United States Atomic Energy Commission has developed a program to train physicians and to orient hospital staffs in the treatment of accident victims. Seminars have been conducted to date for approximately 120 physicians on medical planning and care in radiation accidents. The scope and specific topics covered in the seminars, together with an analysis of experience gained during development and presentation of the seminars, are discussed. More recently the program has been expanded to encompass orientation of hospital administrators and other para-medical personnel on the handling and admittance of victims of radiation accidents. The latter problem is the subject of a color film premiered at the Symposium. (auth)

7886 HEALTH PROBLEMS IN RADIATION ACCIDENTS. Krotkov, F. G.; Terman, A. V. pp 535-46 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In Russian).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

A radiation accident is defined as a situation which has led or could have led to the unexpected irradiation of persons or contamination of the environment over and above the levels accepted as safe. Several categories of accidents are distinguished as a function of the consequences to be expected. The suggested system of classifying accidents makes it possible to plan post-accident measures taking into account at the same time whether it will be possible to carry out the post-accident measures unaided or whether it will be necessary to bring in additional manpower and resources from outside. The possibility of countering the effects of accidents as a function of their nature, with reference to the biological, economic, and psychological aspects is discussed. The part played by the health service in planning and carrying out accident prevention measures and the function, of radiological units attached to epidemiological health stations are reviewed. These units are essentially centers providing for precautionary measures to avert accidents and action to counter their effects. (auth)

7887 THE ADOPTION OF URGENT MEASURES TO PROTECT THE POPULATION IN THE EVENT OF AN ACCIDENTAL RELEASE OF RADIOACTIVITY INTO THE ENVIRONMENT. Dikobes, I. K. (Ministry of Health, Moscow); Il'in, L. A.; Kozlov, V. M.; Moiseev, A. A.; Konstantinov, Yu. O.; Tarasov, S. I.; Shamov, V. L. pp 547-58 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In Russian).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

A situation in which there is a risk of the population being seriously exposed to radiation through the accidental entry of radioactive material into the environment is considered. The specific features of the situation under consideration are such that the appropriate protective measures can only be effective if implemented in time, i.e., within the first few hours or days of the emergency. Hence a program providing for protection of the population against radiation in an emergency should include methods by which the dosimetric information required for a rapid evaluation of the potential radiation hazard can be promptly obtained, and criteria for the adoption of urgent measures, i.e., the levels of radioactive contamination or irradiation justifying or not justifying the need for the implementation of specific protective measures. Recommendations on which to base such decisions are presented. The criterion for the decisions is based on two hazard levels for each of the irradiation paths, potentially significant in the given situation, these include external and contract irradiation, inhalation, and contamination of foodstuffs. Decisions to adopt immediate protective measures should be based on a comparison between the evaluated (predicted) hazard levels and the critical levels, defined as those hazard levels at which implementation of the protective measures under consideration is desirable or obligatory, irrespective of the specific circumstances. Figures for the critical levels are chosen with regard to the specific nature of the situation and protective measures, maximum permissible levels for occupational exposure, and known information on the biological risk of certain exposure levels. (auth)

7888 ORGANIZATION OF OUTSIDE ASSISTANCE IN THE EVENT OF NUCLEAR ACCIDENTS. Letourneux, A.; Douard, J. (Direction Generale de la Protection Civile, Paris). pp 675-81 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In French).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

In 1952 the French Civil Defence Service drew up an overall plan for emergency measures known as the ORSEC plan. This plan, which is based on an inventory of emergency services in the French Departments, makes it possible to muster and utilize all serviceable personnel and equipment in the event of a major accident or disaster. It has been necessary to incorporate special studies into the plan in order to face new hazards. The ORSEC-RAD plan is specifically designed to permit the adaptation and co-ordination of the emergency services in case of accidents with consequent radioactivity involving: stationary civil installations, carriers of radioactive materials, military bases, and aircraft accidents. The advantage of such organization stems from prearranged collaboration between the public authorities, organizations, and establishments concerned. In this way it has been possible to minimize the overlapping of personnel and equipment without reducing efficiency. Establishments presenting possible radiation or contamination hazards are governed by strict regulations. It may happen, however, through human error or material failure, that the assistance of outside emergency services becomes necessary. (auth)

7889 ASSESSMENT OF THE POTENTIAL RELEASE OF RADIOACTIVITY FROM INSTALLATIONS AT AERE, HARWELL. IMPLICATIONS FOR EMERGENCY PLANNING. Flew, Elizabeth M.; Lister, B. A. J. (Atomic Energy Research Establishment, Harwell, Eng.). pp 653-68 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

As part of a review of the site emergency organization at AERE, a realistic reappraisal was made of the potential hazard to the establishment and district from each of the buildings containing significant amounts of radioactive materials. To assess the amount of radioactive material which might be released under specified accident conditions, four factors were applied to the total building stock including the fraction of the stock involved; the percentage conversion to an aerosol form, release from primary containment, and release from the building. These potential release figures were compared with site hazardous release figures for relevant radionuclides, i.e., amounts which could give rise to exposure above defined reference levels. Those buildings with more than one tenth of the potential for causing a site or district hazard were designated as risk buildings. Such a quantitative assessment, although necessarily very approximate, has been of considerable value in determining the type and complexity of the central emergency organization required and in producing the right emphasis on exercises, training, and liason with outside agencies. (auth)

7890 EVALUATION OF THE RISKS RUN BY WORKERS DURING EMERGENCY EXPOSURES. Recht, P. (Commission des Communautes Europeennes, Luxembourg). pp 639-51 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In French).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The implications of emergency radiation exposures are discussed. Criteria are presented for use in the evaluation of such exposures, and radiobiological data on which to base the maximum permissible exposure are included. It is pointed out that hazard evaluation is a complex matter. The dose/effect ratio can only be given in semi-quantitative terms. Interpretation of radiobiological data remains a problem of concern for the health

authorities and the doctors and physicists responsible for taking decisions at the time of an accident or an emergency exposure. (auth)

7891 PLANNING, IMPLEMENTING, AND ASSESSING SITE EMERGENCY PROCEDURES AT CIVIL POWER STATIONS IN THE UNITED KINGDOM. Emmerson, B. W. (Central Electricity Generating Board, Bradwell-on-Sea, Eng.). pp 615-37 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

It is a statutory requirement that each Nuclear Power Station in the United Kingdom must produce and exercise an emergency plan designed to deal adequately with any accident or other emergency on site which could lead to the release of significant quantities of radioactive material. The organization involved in implementing these requirements at local level, including the design of emergency plans, the provision of emergency equipment, and the training of site personnel in emergency duties is discussed. The need for rapid and precise action to re-establish plant control and thereby limit the potential hazard to the site and external environment is of prime importance. This, together with the location and rescue of casualties from the affected plant presents considerable problems in the control of emergency workers, particularly in terms of accumulated dose and the need to guard against an asphyxiating atmosphere. An actual full scale demonstration of an emergency exercise carried out at Bradwell Power Station is described. The problem of equating the results with those which would pertain under actual conditions is discussed. (auth)

7892 BASIC PRINCIPLES OF EMERGENCY PLANNING AND ORGANIZATION FOR FAIRLY SMALL NUCLEAR ESTABLISHMENTS. Mahmoud, K. A.; El-Naggar, A. M. (Atomic Energy Establishment, Cairo). pp 605-14 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The organization of emergency procedures in the event of a radiation accident within a small nuclear establishment is discussed briefly. The procedures to be adopted at the UAR Atomic Energy Establishment are also presented and typical examples of simple and effective types of emergency equipment mentioned. It is recommended that the owner or operator of the establishment should be aware of the expected damage to personnel and property should a maximum credible accident occur. For this reason it is essential that he should appoint an Emergency Planning Committee. This committee should be responsible for the necessary planning and execution of the emergency procedures and should seek the help of public authorities within the country whenever necessary. It is also the task of this committee to establish, organize, and select the most adequate radiation protection personnel and equipment. These should include the emergency control center; stationary radiation monitoring posts; radiation monitoring teams and mobile laboratories; evacuation procedures (if necessary); radiation monitoring and segregation of personnel, medical management of casualties; and subsequent surveys, including decontamination and waste management. (auth)

7893 EMERGENCY PLANNING AT THE EURATOM RESEARCH CENTRE, ISPRA. Dominici, G.; Malvicini, A.; Markovina, A.; Tomassini, G. (CCR-EURATOM, Ispra, Italy). pp 595-604 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The problem of organization of aid in the case of a radiation accident at a center comprising a large number of installations of a varied nature is discussed in general terms and some selected basic aspects of this problem are defined. A description is given in broad outline of the organization of radiation protection programs at the ISPRA establishment that includes the operation of three reactors, one subcritical assembly, and several hot-cell laboratories, with regard to the system of alarm and classification of accidents, measures to be taken for first aid auxiliary services, evacuation procedures, and the declaration of an emergency situation. (auth)

7894 APPARENT EXCESSIVE DOSES FROM RADIATION IN UNITED KINGDOM FACTORIES. Burgess, C. D. (Dept. of Employment and Productivity, London). pp 525-33 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The legislation governing exposure to radiation of factory workers in the United Kingdom is described. The differences between this legislation and the recommendations of the International Commission for Radiological Protection are stated. The requirements of this legislation are interpreted and the action required of the factory occupier and others in the event of an apparent radiation dose in excess of the maximum permissible dose is explained. The problems which arise in determining whether the apparent dose is a true overdose and the consequent suspension of a worker from work involving exposure to ionizing radiations are discussed. The statistics for 1968 in relation to apparent overdoses notified to the Inspectorate are given. These statistics indicate in which industries the overdoses occur, the degree of exposure, and the causes of them. (auth)

7895 RADIATION ACCIDENT EXPERIENCE: CAUSES AND LESSONS LEARNED. Catlin, R. J. (Atomic Energy Commission, Washington, D. C.). pp 437-50 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

Since inception of the nuclear energy program in the United States of America, the Atomic Energy Commission (USAEC) has maintained an extensive system for the reporting and review of radiation accidents in USAEC federal and licensing activities. Accidents required to be reported fall into the two main categories of accidents causing or threatening to cause radiation exposure to industrial workers or to the general public, and accidents causing damage to or shutdown of facilities, or damage to public property. While many of the reported accidents carry with them the potential for exposure of persons to radioactivity, the cases reported in this analysis are limited to those where certain prescribed levels of exposure have been exceeded or where significant uptake by the critical organ has occurred. Detailed analyses of the accident experience encountered in USAEC programs over the past nine years are presented, including a breakdown of the types of work activities in the nuclear industry under which radiation accidents have occurred; characterization of the causes of such accidents as related to the types of work activities; and lessons to be learned both in avoiding such accidents and in emergency planning, should such accidents occur. (auth)

7896 STUDY OF A CASE INVOLVING ACCIDENTAL IRRADIATION OF A HUMAN BEING. Beninson, D.; Placer, A.; Vander Elst, E. (Comision Nacional de Energia Atomica, Buenos Aires). pp 415-29 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In Spanish).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

A description is given of an accident involving extremely uneven irradiation (ranging from 50 rads to 1.7 Mrads), in which a worker carried a ^{137}Cs source belonging to an industrial gamma radiography unit in his trouser pockets for a total period of 18 hours. This resulted in low irradiation of the hematopoietic and gastrointestinal organs and skin. The front of the thighs, the inguinoscrotal region, and to a lesser extent the hands, were the areas most affected. The radiation doses delivered to the affected areas were estimated from biological radiation dosimetry parameters (the extent and chronological order of some of the lesions) and from experimental data on the dose as a function of distance and depth of the tissues, obtained by reconstructing the accident with a phantom and a set of thermoluminescent dosimeters. The appearance of wet radiation dermatitis a few days later is described. These areas gradually grew until they reached approximately the limit represented by the 1000 rads isodose line. Progression of the radiation dermatitis was complete after about 30 days and was followed by epidermal desquamation extending approximately as far as the 500 rads line. With the passage of time there occurred muscular atrophy of both legs and extensive edema of the inguinoscrotal area. The appearance of extensive femoral hemorrhages after six months made it necessary to amputate first the lower left limb, and then the right. The rate of chromosomal aberrations in the peripheral blood confirmed the low doses absorbed by the blood system (about 50 rads). A summary of results of the analyses made is given, together with comments on the prognosis of the patient's recovery, based on the distribution of the radiation dose received. (auth)

7897 REPORT ON OVER-IRRADIATION OF A RESEARCH WORKER'S HAND: PHYSICAL AND CLINICAL DOSIMETRY. Evans, J. C.; Orr, R. G. (Atomic Energy Research Establishment, Harwell, Eng.). pp 431-5 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

A research worker handled a high-activity fission product β source. The detection of the origin of the subsequent lesions on

the hand, and the clinical development of these lesions are described. An account is given of the dose estimates made subsequently. The final estimate was 1200 to 1400 rads. (auth)

7898 ACCIDENTAL RADIATION EXPOSURE FROM ^{192}Ir CAMERA. Maxfield, W. S. (Louisiana State Univ., New Orleans); Porter, G. H. pp 459-67 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

Two radiographers received accidental radiation exposure from an ^{192}Ir camera when the source became disconnected from the control cable. The accidental exposure was discovered when all films taken over a 2-hour period were found to be black. Survey instruments were inoperable at the time of the exposure. The film badge reading on one individual was 12 R and the other was 25 R. The individual with 12 R exposure showed no sequels from the radiation exposure. The individual with 25 R at seven days post-exposure noted discomfort in the right ring and little finger. Examination at this time showed slight swelling of the fingers which had been normal 24 hours after exposure. Over the next two weeks the patient developed marked blistering of the palm of the ring and little fingers. It is interesting that though the ^{192}Ir camera is predominantly a γ emitter, the injury to the hand was of a β or an electron-contamination type, since the dorsum of the hand showed minimal abnormality during the period of observation, in spite of blistering of the palmar surface. The damage to the hand was treated by conservative management with excellent result, the residual disability being slight limitation of motion in the distal digit of the ring finger. (auth)

7899 ASSESSMENT OF THE PROBABILITY OF RADIATION ACCIDENTS AT NUCLEAR POWER STATIONS. Bobrovnikov, O. P.; Belyaev, V. A.; Gusev, N. G.; Mikhailov, L. M. (Inst. of Biophysics, Moscow). pp 471-81 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In Russian).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

A method is proposed for assessing the probability of radiation accidents at nuclear power stations. It was found that radioactive gas releases follow a log-normal distribution law. Criteria are proposed for assessing quantitatively the likelihood of radiation accidents at nuclear power stations. (auth)

7900 EMERGENCY MEASURES IN THE EVENT OF A NUCLEAR ACCIDENT AT THE BORIS KIDRIC INSTITUTE, VINCA. Bojovic, P.; Djukic, Z.; Mitrovic, S. (Boris Kidric Institut des Sciences Nucleaires, Belgrade). pp 483-92 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In French).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The fields of study at the Boris Kidrič Institute of Nuclear Sciences at Belgrad, Yugoslavia, that are important for the evaluation of potential radiation accidents, and also the obligations imposed by law on the Institute as regards its own service for protection against ionizing radiations are described. Also described is the organization of radiological protection at the Boris Kidrič Institute, where the Radioprotection Laboratory and the Medical Protection Laboratory take the appropriate action and provide technical equipment in the event of an accident with ionizing radiation sources. The necessary planning, the action to be taken to identify the nature and extent of the accident, and operations required to eliminate the consequences of the accident are discussed. (auth)

7901 ORGANISATION IN THE HARWELL RADIOCHEMISTRY LABORATORIES FOR DEALING WITH RADIATION ACCIDENTS. Hudswell, F. (Atomic Energy Research Establishment, Harwell, Eng.). pp 493-509 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The radiochemistry laboratories contain extensive facilities for the handling of large quantities of α emitters and β/γ active materials. Safety in this area is surveyed by a local safety committee, which has been responsible for the development of both the working rules for the avoidance of radiation accidents and the organization for dealing with them should they occur. The emergency control organization within the high activity area is linked with and approved by the organization. Local control within the building can be undertaken by any one of a number of senior staff who is advised by a health physicist, engineer, and other scientists, and who delegates executive responsibility for emergency stations to a number of scientific and engineering staff. An incident in the area which affects other areas in the establishment is controlled by the establishment emergency organization, but will also involve the local control post as a source of action and information. Reciprocally, local control may be required to receive evacuees from a remote incident area. Safety manuals and emergency plans are revised periodically. Exercises are mounted several times a year and are followed by discussions of the weaknesses found. Attempts are made to remedy the weaknesses in subsequent exercises. (auth)

7902 CO-OPERATION IN THE EVENT OF NUCLEAR ACCIDENTS. Bresson, G. (CEN, Fontenay-aux-Roses, France). pp 511-23 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In French).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The action to be taken in respect to personnel directly affected by a radiation accident is discussed. Criteria for classifying nuclear establishments, and the relationship between the establishment and the hospital, and between the radiation protection experts and medical personnel, are discussed. The complex organization of emergency measures, reception of the victim of the accident, and the treatment possibly required should be based on standard practice and published material, both national and international, allowance being made for the characteristics of each sector. A flexible plan of co-ordination is given as an illustration. Action must be taken in such cases at the site of the accident, inside and outside the establishment, and above all at the hospital. All categories of persons are involved in the process, i.e., fellow-workers, management, specialized services, and medical personnel, each with their own part to play. The manpower and equipment brought into service therefore vary, and depend upon the internal and external relations maintained by the establishment. The measures envisaged should provide for the transport, reception and treatment of those involved in the accident. An existing organization of this kind is described as an illustration. No action can be of value without full knowledge of the facts and thorough training of the personnel. Some clearly defined ideas on the subject are considered. (auth)

7903 A REVIEW OF DECONTAMINATION AND WASTE DISPOSAL CONCEPTS APPLICABLE TO A MAJOR REACTOR ACCIDENT. Horan, J. R. (Atomic Energy Commission, Idaho Falls, Idaho). pp 343-62 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

Although radiation accidents involving significant releases of radioactivity from nuclear reactors have been rare events and the future frequency cannot be predicted, we know that such releases must be planned for. Any major release of radioactivity from a reactor system will result in extensive contamination of building interiors and equipment as well as the possible escape of contamination to exterior facilities and the immediate environment. The choices confronting management before, during, and after initiation of cleanup operations are discussed. Regardless of what decisions are made, the resulting actions will be difficult and complex and will make heavy demands on all resources. Even with the best preplanning, radiation exposure will range from hundreds to thousands of rems, total costs will be in the hundreds of thousands to millions of dollars, units of equipment will be used by the hundreds and thousands, and the time required will be measured in months or even years. The two major considerations will be the control of personnel exposures and overall costs. One of the practical lessons learned from prior accidents is the need for protective coatings on the structural surfaces and walls of reactor buildings to facilitate remote decontamination. Also learned was the need for constant good housekeeping to avoid unnecessary contamination to equipment, tools, instrumentation, and supplies. Proven and new techniques for handling cleanup problems are reviewed, with particular emphasis on treatment and disposal of the resultant wastes. The magnitude of waste disposal can range from thousands to millions of gallons of liquid and thousands to tens of thousands of cubic yards of solids. Waste management will constitute one of the most hazardous, expensive and time consuming phases of the recovery effort. (auth)

7904 ACTION TO BE TAKEN IN THE EVENT OF A SERIOUS NUCLEAR ACCIDENT IN AN INDUSTRIAL ESTABLISHMENT. Kissel, Ph.-P.; Chapuis, Anne-Marie (CEN, Fontenay-aux-Roses, France). pp 43-75 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In French).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

A detection and alarm system is described for a facility where there is risk of a criticality accident. The action required for evacuation of personnel to an assembly point is outlined. Details

are given of the layout and equipment envisaged for an assembly point of this kind, facilitating the rapid counting of the personnel and the segregation of persons who may have been contaminated or irradiated. A description is also given of the dosimetric techniques used for this initial segregation and the arrangements adopted for area and personal monitoring with a view to providing the specialized medical services with the data necessary for treating irradiated persons. The standards adopted in France relating to area monitoring indications and the marking of evacuation routes, on the one hand, and conventional signs, on the other, in a plan of action for radiation protection are given. (auth)

7905 RADIATION SICKNESS COMBINED WITH BURNS. Messerschmidt, O. (Univ., Freiburg i. B.); Birkenmayer, Eline; Boemer, H.; Koslowski, L. pp 173-9 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

Whole-body irradiations following radiation accidents in reactors and other atomic energy installations may be combined with burns. The effect of these combined injuries will generally result in an aggravation of the radiation sickness. Our experiments on mice have demonstrated that the prognosis and the course of the clinical picture of this disease depend on the time factor, i.e., the time interval between irradiation and burns as well as the sequence of the injuries. (auth)

7906 PSYCHOLOGICAL ASPECTS OF ACUTE RADIATION ACCIDENTS. Bunin, S. M. (Hanford Environmental Health Foundation, Richland, Wash.). pp 189-97 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

Personality structure and needs are described and then related to the psychological aspects of radiation injury. Three levels in the personality structure are defined as child, adult, and parent. This is followed by a description of two major need systems, the first of which, if not met, results in the death of the individual and the second, if not met, results in significant emotional disruption of the individual. This is followed by a discussion of coping phases and stress patterns of radiation injury, including the effects of the illusion of immunity characterized by the feeling that things can happen to others, but not to me, and the nuclear mystique which is characterized by a magical quality attached to radiation due partly to the lack of sense organ response to radiation exposure. Following impact, treatment in the reactive phase, which includes moderate and severe emotional reactions, involves a series of compensating emotions. These include the illusion of centrality, the feeling of abandonment, altruism, and amorality. The aftermath reaction is treated from the standpoint of the tormenting memory, the amnesiac reaction, the fear of recurrence, and the individual's need to cope with both his medical condition and reactions of others to his condition. The recovery phase is treated from the standpoint of unacceptable and acceptable disability. A recommended psychological treatment for the physician to use in radiation accident cases is made involving the individual's psychological needs, as well as the physician's psychological role which includes: authoritative support, acceptance, optimism, and avoidance of the appearance of an overly scientific approach. Effective organizing, planning, or training for the care of radiation accident cases must consider the psychological factors developed. Recommendations for mental health programs which include employee screening and counselling programs are made. (auth)

7907 FOLLOW-UP OF PERSONS OCCUPATIONALLY OVER-EXPOSED TO IONISING RADIATIONS. Duncan, K. P. (United Kingdom Atomic Energy Authority, Harwell, Eng.). pp 21-30 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The number of occasions on which workers are overexposed to ionizing radiations is very small even when the definition of an overexposure is taken as being any amount in excess of an ICRP permissible level. There is a need for the fullest information about the prognostic significance of overexposures to be obtained. While it is true that much larger radiation doses are incurred in therapy, or even in some x ray diagnostic procedures, there are other factors, such as underlying diseases, which can complicate the interpretation of biological consequences in these cases. Therefore, a simple system of registration for all overexposures to workers should be introduced. Such a system should cover only the relatively small number of cases either of external radiation or of internal contamination in which the dose can be considered likely to be in any way significant in respect of ultimate prognosis. Any necessary administrative effort should be made available by a critical review of the effort devoted to the routine recording of very low doses. An example of a registration system which has been instituted in the United Kingdom is outlined and the reasoning behind the limited amount of recording which is considered to be useful is discussed. In addition to statistical studies of overexposures, there is a need to apply sound occupational health principles to the supervision and future employment of workers involved in such incidents. These should reflect an individual assessment of all aspects of such cases and rule of thumb numerical rules should not apply. Relevant factors in these individual assessments are discussed. (auth)

7908 MEDICAL ACTIONS IN EMERGENCIES AT NUCLEAR POWER STATIONS. Bonnell, J. A. (Central Electricity Generating Board, London). pp 105-15 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

Casualties which could occur as a result of accidents at nuclear power stations can be categorized as follows: those caused by over-exposure to external radiation; excessive contamination of body surfaces with radioactive materials resulting in absorption of toxic quantities of these materials; or combinations of these complicated by traumatic injuries. The arrangements made within the Central Electricity Generating Board, United Kingdom, or dealing with casualties, taking account of the limited medical and nursing facilities, are discussed. These arrangements include immediate actions on site, including first aid and rescue; plans made for the medical staff of appropriate hospitals for dealing with eventualities of this nature; adequate training programs to ensure nursing and first-aid teams; and plans for rehabilitation and reemployment of injured personnel. Details of dosimetry, both physical and biological, which would be used to assess the extent of radiation exposure are described. (auth)

7909 VALUE OF DETAILED ANALYSIS OF RADIATION ACCIDENTS WITHOUT IMMEDIATE INJURY. Klener, V. (Inst. of Radiation Hygiene, Prague). pp 95-103 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

In Czechoslovakia the emergency unit responsible for medical aid and all other measures taken in radiation accidents is based at the Institute of Radiation Hygiene and the Clinic of Occupational Diseases of the Charles University in Prague. Some cases of accidental external irradiation and a greater number of persons with internal contamination have been treated over the past years. In no case was the exposure high enough to endanger the lives of the persons involved. Nevertheless, most cases were subjected to a detailed analysis, comprising both a survey in their place of work and medical examinations and follow-up. Some examples of external irradiation and internal contamination are discussed. From the results given it is evident that a detailed analysis is of great importance even in cases without immediate injury. From the results of medical examinations it is, as a rule, possible to complement significantly the picture of the mechanism of the accident and to disclose the deficiencies in the radiation safety measures of the workplace. Detailed investigation of cases of internal contamination provides new data on the kinetics of nuclides in the human organism in relation to the chemical or physico-chemical form of the contaminant. The alerting of the emergency team for these small accidents provides very good training for more disastrous situations. (auth)

Civil Defense

7910 MANAGEMENT OF MASS CASUALTIES. Sanford, Jay P. (Univ. of Texas Southwestern Medical School, Dallas). J. Okla. State Med. Ass.; 62: 51-3(Feb 1969).

In the event of nuclear warfare involving the detonation of a thermonuclear device, blast, thermal, and radiant energies would be approximately 50, 35, and 15%, respectively of the total release. The detonation of a 20 megaton device at an optimal height under ideal weather conditions would result in an overpressure of 5 psi at a radius of 7.74 miles from ground zero, second-degree burns (7.5 cal/cm^2) at 31.9 miles, and initial radiation levels of 700 rads at 2.27 miles. Such energies can produce large numbers of casualties over large areas. The types of injuries that would occur are not new to the medical profession; rather, the problem involves medical capacity for handling the number of casualties that would occur virtually simultaneously. This problem gives rise to the concept of mass casualties, which is derived as a ratio of medical resources to number of casualties. Assuming the foreknowledge of an attack, the availability and use of a shelter, and

the initial efforts of nonprofessional individuals skilled in first aid procedures, the number of casualties requiring professional care will still be extensive. A system of casualty sorting (triage) is proposed for individuals requiring medical attention following an attack. According to this system, patients are classified by type and severity of injury to provide for the optimal achievement of medical care. Inherent in the triage system is the process of sorting based on prognosis. This is conceived as a fluid, not static, process whereby as an individual's condition changes he is reclassified consistant with optimal medical care in, at best, suboptimal conditions. (E.R.B.)

Legal Aspects

Refer also to abstracts 7769, 7812, 7864, 7867, 7868, 7875, 7880, 7904, and 8013.

7911 (NP-17968) THE LEGAL ASPECTS UNDER JAPANESE LAW OF AN ACCIDENT INVOLVING A NUCLEAR INSTALLATION IN JAPAN. Coleman, Rex; Rabinowitz, Richard W. (Harvard Univ., Cambridge, Mass. Harvard Law School). [nd]. 101p. Dep.

Japanese laws applicable to compensation of persons other than plant personnel for damage to person or property caused by nuclear accidents are discussed. Provisions of the Code of Civil Procedure dealing with liability that may be applicable in the event of an accident involving a nuclear reactor, a nuclear fuel reprocessing facility, or a radioactive waste disposal facility that results in death, personal injury, or property damage are cited. Questions of civil law contractural and tort responsibility, civil procedures, and conflict of laws are discussed by members of the Japanese bar and Japanese professors of law. (C.H.)

7912 SETTING DOSE LIMITS FOR THE PUBLIC. Sowby, F. D. (International Commission on Radiological Protection, Sutton, Eng.). pp 215-19 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Those responsible for the planning of operations that result in radiation exposures of the public require basic standards for limitation of the dose to individuals and populations. Such standards are essential for the proper design and location of buildings, and for the fixing of appropriate levels of released activity. To this end, dose limits for members of the public and for populations have been recommended by ICRP. The dose limits are intended to correspond to a level of biological risk that will be generally acceptable, given the need for the exposure. Dose limits for individual members of the public are, for various reasons, lower than those recommended for adult radiation workers. Dose limits for members of the public also differ from the maximum permissible doses recommended for workers in that it is seldom practicable to monitor individuals in the public to ensure that dose limits have not been exceeded; instead, this assessment is made by environmental surveys designed to identify the group of people likely to receive the highest dose. In any particular set of circumstances in which radionuclides are released to the environment there will be a group of people in the population whose characteristics and habits are such that their exposure will be critical. It is most important therefore to identify this critical group, whose appropriate dose limit will determine the permitted level of released activity. It must be emphasized that the Commission's recommended dose limits, which are intended for normal planning purposes, are set at a level where the risk is considered to be very low. In abnormal conditions, dose limits would need to be exceeded by a considerable amount before remedial action, with its attendant risks, would be warranted. (auth)

7913 AGENCY STANDARDS AND CODES OF PRACTICE RELEVANT TO RADIOACTIVE CONTAMINATION OF A PUBLIC ENVIRONMENT. Daw, H. T. (International Atomic Energy Agency, Vienna). pp 221-9 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The Agency standards and codes of practice relevant to environmental contamination are briefly discussed. Those particularly pertinent to environmental contamination as a result of normal routine operations, such as waste disposal and controlled releases, are explained. Codes of practice and guide books relating to emergency situations involving health safety hazard evaluation and guidelines for decisions for action in case of a radiation emergency involving the public are explained with outlines of the background philosophy. (auth)

7914 NATIONAL AND INTERNATIONAL ASPECTS OF LEGAL AND ADMINISTRATIVE MEASURES RELATING TO WASTE CONTROL AND PROTECTION OF THE PUBLIC. Lafontaine, A. (Institut d'Hygiene et d'Epidemiologie, Brussels). pp 669-76 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969). (In French).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Under what are considered normal conditions, the authorities should grant permission for the discharge of waste materials on the basis of the radiological capacity of the environment and the need to have storage facilities for waste that cannot be discharged. There should be provision for continuous monitoring and inventory-keeping. Equipment should be provided for limiting and slowing down accidental dispersions, and environmental monitoring should be carried out in cooperation with the authorities. In anticipation of exceptional circumstances, in particular accidents, the authorities should require a safety report, an emergency organization and an emergency plan. The monitoring should extend to both the site and its surroundings (fixed and mobile installations in the areas under surveillance, having regard to critical radionuclides, critical biological cycles and critical groups of the population). The international aspects of the problem include transmission of information on the radioactivity of the atmosphere and water, collaboration with neighboring countries that might be affected by the facility (at the stage of the preliminary studies and also when the safety report and the emergency plan are prepared), issuance of immediate warning in the case of accidents and, if possible, co-operation in implementing emergency measures and, lastly, supplying information regarding transport operations and movements of nuclear-powered vehicles. (auth)

7915 LEGAL CONTROL OF DISCHARGE OF RADIOACTIVE MATERIALS IN YUGOSLAVIA. Mitrovic, S.; Jovic, B.; Petrovic, S.; Veljkovic, T. (Boris Kidric Inst. of Nuclear Sciences, Vinca, Yugoslavia). pp 689-93 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Current Yugoslav legislation in the field of discharge of radioactive material is reviewed. Special attention is paid to the problems arising from practical applications which require administrative control. A summary of the work on future administrative regulations is given with special regard to the federal constitution of Yugoslavia. (auth)

7916 ARRANGEMENTS FOR HANDLING RADIATION EMERGENCIES WITH SPECIAL REFERENCE TO MUTUAL AID FROM NATIONAL AND INTERNATIONAL RESOURCES. Swindell, G. E. (International Atomic Energy Agency, Vienna). pp 695-702 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

An outline is given of the essential features of national plans for the handling of radiation accidents. This outline is based on the recommendations of a manual which has been prepared by the IAEA in collaboration with WHO, FAO and ILO and which will be ready for publication in the near future. Taking into account the normal allocation of responsibilities for the control of radiation sources, it covers such topics as the classification of radiation accidents and the organizations which public authorities and operators should set up for handling such accidents and the associated emergency situations. The paper also reviews the role of international organizations in facilitating the provision of international emergency assistance and also in helping Member States to build up their capabilities for handling emergency situations without assistance from outside the country. (auth)

7917 POSSIBLE TRENDS IN THE RESPONSIBILITIES OF PUBLIC AUTHORITIES WITH RESPECT TO ENVIRONMENTAL CONTAMINATION BY RADIOACTIVE WASTES. Lafontaine, A. (Institut d'Hygiene et d'Epidemiologie, Brussels). pp 703-9 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969). (In French).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Measures which may have to be taken in connection with the monitoring of contamination and the role which public authorities might be required to play are discussed. Various aspects of the problem are presented, such as co-ordination of the surveillance carried out by the facility with that performed by the authorities over the entire area (the fact that large facilities are subjected to surveillance should not be a reason for ignoring the small ones or neglecting the problems of transport and nuclear propulsion); extension of emergency plans to off-site accidents; contamination hazards from other sources; collaboration with veterinary and agronomical services; the need to recommend reference values for use when action has to be taken and to inform the authorities of operational incidents, not for reasons of administrative interference but in the interest of drawing conclusions as to safety; and lastly, undertaking future-oriented epidemiological surveys to get an objective idea of the real situation. (auth)

7918 POSSIBLE FUTURE TRENDS IN ADMINISTRATIVE RESPONSIBILITIES. Neal, W. T. L. (Ministry of Agriculture, Fisheries, and Food, London). pp 711-15 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

Although in general terms administrative responsibilities in the field of radiological protection will remain the same in the foreseeable future, nevertheless, the manner in which these responsibilities are implemented may undergo considerable change. It is suggested that the time has come for radioactive pollution of the environment from the peaceful uses of atomic energy to be regarded simply as another form of industrial pollution, and it is argued that administrations should develop new perspectives in the field of public health and that the major effort should be placed where it will do most good. In this context radiation exposure resulting from the peaceful uses of atomic energy will come low on the list of priorities. (auth)

7919 THE CONTROL OF RADIOACTIVE WASTE DISPOSAL FROM BOTH NATIONAL AND INTERNATIONAL VIEWPOINTS. Browder, F. N.; Parsons, P. J.; Phoung, Ha-vinh (International Atomic Energy Agency, Vienna). pp 717-23 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The disposal of radioactive wastes must be strictly controlled to ensure that the amounts which can be released will cause no hazard to man or his resources. The economic pressure to increase such releases should be countered by safety considerations. The control both of the use of radioactive materials and their discharge into the environment is best vested in a central authority through the enactment of appropriate legislation. The basic legislation should establish a system of both licensing users or facilities and authorizing disposals. Such legislation should contain no figures so as to avoid inflexible and overrestrictive limits that might hinder the growth of nuclear applications. Safety limits would be better given in licenses, authorizations or exemption orders that could be subject to easy review and modification. At the international level, the IAEA is preparing a register of disposal of radioactive wastes into international waters. Guiding principles for the control of fresh water pollution have been adopted by the United Nations Economic Commission for Europe and the Consultative Assembly of the Council of Europe through intensive collaboration with other international organizations concerned with water problems. (auth)

7920 NUCLEAR LEGISLATION. ANALYTICAL STUDY. ORGANISATION AND GENERAL REGIME GOVERNING NUCLEAR ACTIVITIES. Paris; European Nuclear Energy Agency (1969). 242p. $6.00.

The general institutional framework consists of political and administrative supervisory authorities, consultative bodies, and public and semi-public agencies. Legislation governing nuclear activities is directed towards nuclear substances, security control, patents, third party liability, and bilateral agreements. These aspects of legislation are outlined for the following countries: Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United States, and United Kingdom. (H.L.W.)

7921 APPLICATION OF SAFETY AND SITING POLICY TO NUCLEAR PLANTS IN THE UNITED KINGDOM. Gronow, W. S. (Ministry of Power, London). pp 549-59 of Environmental Contamination by Radioactive Materials. Vienna; International Atomic Energy Agency (1969).

From Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, Vienna, Austria. See STI-PUB-226; CONF-690317.

The Minister of Power and Secretary of State for Scotland have the responsibility for the safe development of civil applications of nuclear power. The Ministers are empowered by Act of Parliament to make regulations in the interest of safety with respect to the siting, design, construction and operation of nuclear installations, and preparations for any emergency. In a recent review of the safety policy undertaken by the UK Government, it was reaffirmed that the major safeguards for the public lie in the attention given to the engineering of a nuclear plant. In a densely populated country like the United Kingdom, siting makes a limited contribution to the safety of the public. However, full advantage is taken of the possibilities that siting can offer in mitigating the effects of a small release of radioactivity. The chance of accidents leading to such releases is very remote, nevertheless operators are required to make emergency plans for warning and evacuation of persons living closest to the site. To ensure the continued effectiveness of the schemes, limits and controls are exerted on population development around a nuclear site. Arrangements are also made for monitoring milk and other agricultural produce out to greater distances over a longer time scale. The class of site selected for a reactor type is related to the safety characteristics and features of the proposed design. The gas-cooled reactor in a pre-stressed concrete pressure vessel can be designed and constructed in such a manner so as to give a sufficient increase in overall safety that will permit it to be sited on a less restrictive class of site than hitherto. Examples of sites that are now acceptable for this type of reactor are those at Hartlepool and Heysham. Work is proceeding in the United Kingdom on methods of quantifying the probability of the occurrence of reactor accidents in an attempt to define safety standards. This form of analysis is not yet sufficiently developed to provide a basis for safety assessment of complete reactor systems although every encouragement is being given to the development of the method in those areas where it can be applied. (auth)

7922 EXPERIENCE OF THE STATE OF ILLINOIS DEPARTMENT OF PUBLIC HEALTH FOLLOWING THE ENACTMENT OF A LASER SYSTEM REGISTRATION LAW. Courtney, Russell W. (Dept. of Public Health, Springfield, Ill.). Radiol. Health Data Rep., 10: 421-6(Oct. 1969).

The experience of the State of Illinois Department of Public Health, following the enactment of a laser registration law, is presented. The priorities suggested for the inspection of laser systems are high intensity laser systems applied in industrial processes, lower intensity laser systems used in outdoor processes that could potentially expose the general public, lasers used in research institutions, and lasers used as high school and college teaching instruments. At the time of this report, only one accident had been reported to the Department of Health. This accident was a case of electrical shock in which there was no serious injury or loss of work time for the employee. (auth)

Medicine

Refer also to abstracts 7589 and 7737.

Protective Substances

Refer also to abstracts 7466, 7742, 7978, 7983, 7985, and 8000.

7923 PERTECHNETATE ACCUMULATION IN THE CHOROID PLEXUS. Bardfeld, Philip A.; Holmes, Richard A. (Johns Hopkins Medical Institutions, Baltimore). Amer. J. Med. Sci.; 254: 542-8(Oct 1967).

In the use of ^{99}Tc-pertechnetate for brain scanning, a frequently observed focus of increased activity in the temporal region of the lateral views and occasionally in both paramedial areas of the posterior scan was reported. Studies were conducted in rabbits to determine whether pertechnetate is accumulated in the choroid plexus and whether its uptake can be diminished by perchlorate administration. In a large unselected group of human brain scans, the frequency and degree of choroid plexus activity were also examined. The rabbits were injected intravenously with 1.0 mCi of $^{99}TcO_4$, and other rabbits received potassium perchlorate (10 mg) intraperitoneally 4 hr prior to pertechnetate injection. Pertechnetate was shown to concentrate in the rabbit choroid plexus. The administration of perchlorate prior to $^{99}TcO_4$ resulted in decreased accumulation of pertechnetate. In 79% of human brain scans carried out with pertechnetate without the administration of perchlorate, choroidal activity was seen. In 19% of these cases, the activity in the choroid plexus was excessive and may interfere with the

interpretation of the brain scans. It is concluded that routine administration of an oral dose of 200 mg of potassium perchlorate is both a worthwhile and necessary procedure. (BBB)

7924 CONVEGNO SULLA RADIOTERAPIA IPERBARICA, FIRENZE, 14–15–16 SETTEMBRE 1967. (Convention on Hyperbaric Radioisotopes, Florence, September 14, 15, and 16, 1967). De Giuli, G. (ed.). Nunt. Radiol., 34: 1-78(Jan. 1968). (In Italian and English). (CONF-670983).

Separate abstracts were prepared for five papers of the conference for inclusion in NSA. Three other papers covered the problems of anoxic and hypoxic cells of tumors. (C.O.)

For abstracts of individual papers see: 7925–7928 and 7964.

7925 HYPERBARIC OXYGEN AND RADIOTHERAPY: GENERAL PRINCIPLES AND PROBLEMS. Churchill-Davidson, I. (St. Thomas' Hospital, London). Nunt. Radiol., 34: 5-13 (Jan. 1968).

From Convention on Hyperbaric Radioisotopes, Florence, Italy. See CONF-670983.

The principles and problems of using hyperbaric or hypobaric oxygen to radiosensitize tumors are discussed. Problems were divided into three groups: technical, physiological, and physical. It was suggested that the primary hope for improving the results of radiotherapy was to try to increase the amount of oxygen in the blood supply. (C.O.)

7926 FUTURE POSSIBILITIES FOR EXPLOITING THE OXYGEN EFFECT IN RADIOTHERAPY. Wright, E. A. (St. Mary's Hospital, London). Nunt. Radiol., 34: 53-7(Jan. 1968).

From Convention on Hyperbaric Radioisotopes, Florence, Italy. See CONF-670983.

Methodology for improving the oxygen effect in radiotherapy is discussed. Means of possibly reversing the oxygen effect so that tumor cells were oxygenated and highly radiosensitive on the one hand and the normal tissues were anoxic and protected on the other hand are discussed in relation to the following: bringing all tissues to equal oxygen tension, use of radiation with little or no oxygen effect, and use of the oxygen effect to maximum advantage. (C.O.)

7927 OXYGEN AND FRACTIONATION IN RADIOTHERAPY. Du Sault, Lucille A. (Henry Ford Hospital, Detroit). Nunt. Radiol., 34: 59-67(Jan. 1968).

From Convention on Hyperbaric Radioisotopes, Florence, Italy. See CONF-670983.

Oxygen enhancement of radiotherapy of spontaneous tumors in mice was examined for correlation with various aspects of dose-fractionation. No change was found for repetitions of the fraction from once to twenty times or for overall times of 18 to 25 days. It did, however, increase with size of the fractional dose. It was greater for small tumors than for large. The increase in tumor cures and in deaths during the treatment series with oxygen were both found to depend on tumor site, being opposite for the two results of treatment. The therapeutic ratio is thus shown to vary with tumor site. (auth)

7928 QUANTITATIVE ASPECTS OF NORMAL TISSUE DAMAGE TOLERANCE FOR MEGAVOLTAGE IRRADIATION IN HYPERBARIC OXYGEN. Van Den Brenk, H. A. S. (St. Thomas' Hospital, London). Nunt. Radiol., 34: 69-78(Jan. 1968).

From Convention on Hyperbaric Radioisotopes, Florence, Italy. See CONF-670983.

Studies of radiosensitivity of skin of mice and rats in relation to hyperbaric oxygen breathing are reviewed. The decreased tolerance observed permitted reductions of dosage by about 20%. Clinical experience with radiotherapy of advanced cancer of the head and neck region have shown a similar increase in skin radiosensitivity with hyperbaric oxygen, but less difference for mucous membranes and deep tissues. Analysis of dose-effect data on these patients was made using cell survival parameters. Results showed that fractionated doses, which must not be exceeded if normal tissue damage is to be controlled, for wide-field irradiation were defined by the equation $0.4771\ N = 0.0033\ DN - 8$ where N is the number of fractions and D is the rads of dose per fraction for 4 MeV x rays. The spinal cord was more radiosensitive than most tissues. For control of injury under fractionated dose regimes, it was recommended that doses to the cord for hyperbaric oxygen should not exceed those given by the equation. It was concluded that the cord may be somewhat more tolerant to irradiation in air; data available for air treatments were not satisfactory for determination of this point with good accuracy. (C.O.)

7929 A POSSIBLE MECHANISM OF THE ACTION OF CYSTEAMINE ON THE RESPIRATION, OXIDATIVE PHOSPHORYLATION, AND ULTRASTRUCTURE OF THE MITOCHONDRIA OF THE RAT LIVER. Kozyreva, E. V.; Romantsev, E. F.; Mityushin, V. M. (Inst. of Biophysics, Moscow). Radiobiologiya; 9: 558-66(Jul-Aug 1969). (In Russian).

The influence of cysteamine (mercaptoethylamine, MEA) on respiration, oxidative phosphorylation, and the ultrastructure of the mitochondria of the rat liver was studied by a polarographic method. It was shown that the addition of 0.1, 0.3, and 1.0 μmole MEA causes a transitory acceleration of respiration. In the nature of the curves of the polarograms, the action of MEA resembles the action of ADP on mitochondria. The same similarity is observed in the influence of MEA and ADP on the ultrastructure of the organelles. (tr-auth)

7930 INFLUENCE OF CYSTEAMINE ON THE RADIOSENSITIVITY OF MICE OF DIFFERENT LINES AND THE CONTENT OF NONPROTEIN SULFHYDRYL GROUPS IN THEIR HEMATOPOIETIC TISSUE. T'u, Lieh Suang (Inst. of Developmental Biology, Moscow). Radiobiologiya; 9: 630-2(Jul-Aug 1969). (In Russian).

Data showing that the administration of the protector cysteamine produces an equally large increase in the level of nonprotein thiols in the hematopoietic tissue of mice of the BALB/c and $C_{57}B1$ lines, differing sharply in radiosensitivity are presented. The administration of cysteamine also gives the same degree of protection in the case of irradiation of animals of these two lines at doses that induce the same death rates. The radioprotective action of the thiol radioprotector is attributed to an increase in the thiol groups of endogenous origin. (tr-auth)

7931 RADIOPROTECTIVE ACTION OF ACCLIMATIZATION TO HYPOXIA IN CONJUNCTION WITH CYSTEAMINE AND A GINSENG ROOT EXTRACT. Vasil'ev, G. A.; Ukshe, A. N.; Sokolov, V. I. Radiobiologiya; 9: 570-3(Jul-Aug 1969). (In Russian).

The radioprotective effect of cysteamine and a ginseng root extract in conjunction with acclimatization to hypoxia was studied. The observed effect does not exceed the effect obtained from ginseng root alone. Apparently the mechanisms of the radioprotective action of acclimatization to hypoxia and of the drugs tested differ. (tr-auth)

7932 STUDY OF THE PROTECTIVE PROPERTIES OF ARYL-SUBSTITUTED TRIAZOLE AND TETRAZOLE. Kulyabko, P. N.; Dubenko, R. G.; Pel'kis, P. S. (Inst. of Physiology, Kiev. Inst. of Organic Chemistry, Kiev). Radiobiologiya; 9: 633-4 (Jul-Aug 1969). (In Russian).

Data on the radioprotective properties of certain newly synthesized derivatives of triazole and tetrazole are presented. The degree of radioprotective action of the tetrazole derivatives increased when the hydrogen atom in the phenol ring was replaced by a chlorine or bromine atom. 1-p-Chlorophenyltetrazole proved the most effective; its administration before irradiation promoted 56% survival of the experimental mice, as opposed to 100% death of the controls. (tr-auth)

7933 INFLUENCE OF METHYLURACIL ON THE ACTIVITY OF THE PROPERDIN SYSTEM OF THE SERUM OF NORMAL AND IRRADIATED RABBITS. Danilova, T. G. (Kazan Medical Inst.). Radiobiologiya; 9: 620-2(Jul-Aug 1969). (In Russian).

The article presents the dynamics of the activity of the properdin system under conditions of irradiation and stimulation by methyluracil. Methyluracil, which stimulates the activity of the properdin system in normal rabbits, was administered before and after irradiation. An analysis of the results indicated an advantage of introducing methyluracil before irradiation. Possible mechanisms of the disturbance of the activity of the properdin system during irradiation were revealed. (tr-auth)

7934 INFLUENCE OF 5-METHOXYTRYPTAMINE ON THE DISTRIBUTION OF CYSTAMINE IN THE ORGANISM. Titov, A. V.; Mordukhovich, V. V. (Military-Medical Academy, Leningrad). Radiobiologiya; 9: 574-8(Jul-Aug 1969). (In Russian).

5-Methoxytryptamine (5-MOT) produces an increase in the accumulation of cystamine in the lungs, liver, and brain and a decrease in the kidneys and skeletal muscles. The accumulation of cystamine in the spleen and intestines during the period of manifestation of the maximum radioprotective effect is essentially unchanged, but after 1 and 2 hrs it is increased. The increased accumulation of cystamine in the brain under the influence of 5-MOT is one of the causes of the intensification of the toxic effect. (tr-auth)

7935 CHANGES OF THE HEART EXCITABILITY FOLLOWING INTRAVENOUS ADMINISTRATION OF AMINOETHYLISOTHIOURONIUM BR. HBr (AET). Kuna, Pavel; Vokrouhlicky, Lubor (Karlovy Univ., Hradec Kralove, Czech.). Voj. Zdravot. Listy; 38: 112-18(Jul 1969). (In Czech).

The radioprotective compound aminoethylisothiouronium Br

HBr (100 or 150 mg/kg of body weight i.v.) depresses the sinus node during the 1st min after injection in unanaesthetized rabbits. It produces temporary expressive bradycardia, disorders of A–V transfer and ectopic heart contractions. Modification of pH of AET solution up to 7.3 to 7.5 does not influence the character of ECG pattern changes. Vagotomy or atropin premedication (1 mg/kg i.v.) made 10 min before AET administration or an AET injection of 4 to 6 min duration decrease significantly AET induced bradycardia but do not abolish a significant heart rate retardation. For five days repeated intravenous administrations of AET (150 mg/kg once a day) produce typical temporary changes of the heart excitability as well as the single AET injection. (auth)

7936 INFLUENCE OF CERTAIN PHARMACOLOGICAL SUBSTANCES ON THE TOXICITY AND RADIOPROTECTIVE EFFECT OF SULFUR-CONTAINING PROTECTORS. Strel'nikov, Yu. E.; Zherebchenko, P. G.; Tank, L. I. (Military-Medical Academy, Leningrad). Radiobiologiya; 9: 553-7(Jul-Aug 1969). (In Russian).

It was shown in experiments on mice, rats, and cats that antispasmodic preparations reduce the toxicity of aminothiols. An analogous effect in mice is also exhibited by hydrocortisone. At the same time, stimulators of the central nervous system increase the death of mice from toxic doses of the abovementioned radioprotectors, while derivatives of the phenothiazone series do not change the death rate. The administration of antispasmodics to these animals does not affect the radioprotective activity of cystamine. It is suggested that the mechanisms of the radioprotectors and toxic effects of this group of radioprotectors are independent. (tr-auth)

Radiation Sickness and Injuries

Refer also to abstracts 7755, 7858, 7869, 7883, 7885, 7910, and 8000.

7937 SURGICAL ASPECTS OF RADIATION ENTERITIS. Localio, S. Arthur; Stone, Alex; Friedman, Milton (New York Univ., N. Y. University Hospital, New York). Surg. Gynecol. Obstet.; 129: 1163-72(Dec 1969).

Experience with ten patients who had radiation enteritis is reviewed. Disabling symptoms may occur years after irradiation. The disease may progress, and recurrence may appear years later in areas thought to be normal at an earlier operation. Several of our patients as well as many of those reported in the literature were initially thought to have partial obstruction or other symptoms, secondary to recurrent cancer. Surgical therapy should not be withheld from patients with a previous history of cancer and irradiation after appropriate laboratory and roentgenographic evaluation. We reported two patients in whom colonic carcinoma developed in areas which had been exposed to radiation 19 and 23 years previously. Surgical treatment prolongs life, can be performed with a low mortality rate, and may be associated with metabolic and nutritional problems if resection is extensive. (auth)

7938 PROPHYLAXIS AND TREATMENT OF IRRADIATION COMPLICATIONS. Roth, A.; Ong Oei, L. (Humboldt-Univ., Berlin). Z. Aerztl. Fortbild., 61: 277-80(Mar. 15, 1967). (In German).

Not infrequently, radiotherapy is associated with injuries to the normal tissues adjacent to the tumor site. Various prophylactic and therapeutic procedures are discussed for injuries to skin, mucosa, bone, intestine, and ureters. (H.B.G.)

7939 STUDY OF THE MECHANISM OF THE STIMULATION OF IMMUNOGENESIS AFTER THE INFLUENCE OF RADIATION. Kiselev, P. N.; Semina, V. A. (Central Scientific Research Roentgenoradiological Inst., Leningrad). Radiobiologiya; 9: 540-3(Jul-Aug 1969). (In Russian).

When animals subjected to the influence of sublethal doses of radiation are administered somatotropic hormone, an anabolic steroid (nerobol), and cysteine, normalization of immunogenesis, disturbed by irradiation, is observed. The stimulation of immunogenesis in normal and irradiated animals is associated with an intensification of the repair processes of the lymphoid tissue, an acceleration of lymphopoiesis, an increase in the number of immunocompetent cells, and an intensification of their activity. (tr-auth)

7940 COMPARISONS IN THE MEDICAL MANAGEMENT OF THREE CASES OF PLUTONIUM-CONTAMINATED WOUNDS. Schofield, G. B. (United Kingdom Atomic Energy Authority, Sellafield, Eng.). pp 163-72 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

Three cases are described having small wounds on the fingers contaminated by plutonium. In each patient routine decontamination procedures were carried out which were sufficiently rigorous to ensure that all contamination was removed from the intact skin leaving only that remaining in the depths of the wound. The medical management of these patients followed much the same sort of pattern in each case, i.e., excision of the wound was undertaken and this was either preceded or followed by the intravenous administration of DTPA. However, the times at which these various procedures were carried out varied in relation to each other and to the time of injury, and, therefore, one of the purposes of this paper is to discuss the effect of this time variation on the ultimate wound and total body content of plutonium. In one of the patients an attempt has been made to define the relative effectiveness of small and large quantities of DTPA on urinary plutonium excretion, this being achieved by the alternative administration of the DTPA in doses of 1 g and 0.1 g. (auth)

7941 MEDICAL CARE FOR ACCIDENTAL DEPOSITION OF PLUTONIUM (^{239}Pu) WITHIN THE BODY. Norwood, W. D.; Fuqua, P. A. (Hanford Environmental Health Foundation, Richland, Wash.). pp 147-62 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

With expanding uses of plutonium, chances for accidental deposition within the body are increasing. Metabolism of plutonium within the body is variable, depending on chemical composition, particle size and shape, monomeric or polymeric physical state, route of entry (inhalation or through wounds) and many other factors. A notable exception is the negligible absorption from the gastrointestinal tract. It is difficult to determine lung deposition of poorly soluble plutonium by either bioassay or in vivo counting. The intravenous administration of the chelating agent tri-sodium calcium salt of diethylenetriaminepentaacetic acid (DTPA), soon after an accident, is quite effective in removing soluble plutonium which has been inhaled or deposited in wounds. Conditions requiring prolonged therapy are described. Effectiveness of treatment of ^{239}Pu body depositions is greatly influenced by the solubility of the plutonium at the site of deposition. Size, frequency, and duration of dose of DTPA is recommended. Mice developed fibrosarcomas following subcutaneous injections of 0.064 μCi of ^{239}Pu, while an employee apparently developed a pre-cancerous condition after subcutaneous deposition of only 0.005 μCi. It is our policy to recommend excision of any measurable quantity of ^{239}Pu in a superficial wound when this may be accomplished with little hazard. The maximum permissible deposition in skin or subcutaneous tissue may be much lower than that for depositions in bone, liver, lung or tracheo-bronchial lymph nodes. No limiting value has been set for depositions in wounds by any official body. The surgeon must balance the benefits to be secured against the risk of the operation. A wound bearing ^{239}Pu should be immediately washed with DTPA, normal saline, or water, in that order of preference. Methods of removal of ^{239}Pu from the intact skin are briefly discussed. A U. S. Plutonium Registry will assist in evaluating depositions of ^{239}Pu and effectiveness of therapy by reconciling autopsy findings with previous estimates of organ deposition. (auth)

7942 NEW THERAPEUTIC POSSIBILITIES OF THE POST-IRRADIATION HAEMORRHAGIC SYNDROME. Pospisil, J. (Charles Univ., Prague); Dienstbier, Z.; Skala, E. pp 181-7 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

Hemorrhagic diathesis is one of the dominant symptoms of acute post-irradiation lesion. Hemorrhagic syndrome is caused by the disturbance of hemocoagulation during simultaneous lesion of the vascular system. Epsilon-amino-caproic acid (EACA) administered between the 8th and the 18th day (0.4 g/kg per day) to whole-body irradiated dogs (600 R) partially regulated the post-irradiation disturbance of hemocoagulation. The favorable effect of EACA was verified by in vitro experiments in which the blood of irradiated dogs was used. A repeated administration of EACA in the dose of 0.4 g/kg per day to whole-body irradiated rats (600 R) did not substantially affect the post-irradiation changes in the number of white blood elements; however, its administration to healthy animals caused lymphocytosis. In whole-body irradiated dogs (600 R) we have found lower levels of EACA in the blood up to the 8th day following irradiation as compared with healthy dogs after oral application of EACA. The whole-body irradiation of mice did not increase the acute toxicity of EACA. The daily administration of 0.4 g EACA/kg to whole-body irradiated mice (600 and 700 R) did not change the mortality induced by irradiation. It was concluded that EACA is a suitable compound for a complex therapy of radiation

sickness. The administration of para-amino-methyl-benzoic acid (PAMBA), in spite of a certain improvement of post-irradiation hemocoagulation disturbance, was less efficient. Recent experiments with ellagic acid which significantly affects the post-traumatic hemorrhage in whole-body irradiated rats seem to be very promising. (auth)

7943 POSSIBILITIES FOR IMPROVED TREATMENT OF PERSONS EXPOSED IN RADIATION ACCIDENTS. Andrews, G. A.; Balish, E.; Edwards, C. L.; Kniseley, R. M.; Lushbaugh, C. C. (Oak Ridge Associated Universities, Tenn.). pp 119-35 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The number of persons exposed to acute radiation accidents continues to be small and the clinical experience in handling them is thus obviously limited. The great increase in the use of radioactive materials and the growing number of power reactors constitute greatly augmented potential for accidents, but fortunately the number of accidents is not increasing. There appears to be some shift in the type of accidents, with a relative increase in those in which excessive dose to a small part of the body is the predominant feature. There has been little progress in treating local radiation injury but methods for handling the hematopoietic syndrome are definitely improved. Platelet transfusions provide a powerful aid in managing hemorrhage; the more difficult problem in persons with severe marrow depression is infection. The development of sterile environment facilities and the availability of better antibiotic therapy are important advances. Where these measures are not adequate, more experimental procedures give some promise. These include the injection of concentrated leukemic or normal leukocytes, the use of cross circulation, or the injection of allogeneic bone marrow. Classification of the injury and estimation of its severity are more effectively done now than a few years ago, and contribute to better treatment. (auth)

7944 FACTORS AFFECTING THE MEDICAL MANAGEMENT AND CARE OF PERSONS ACCIDENTALLY OVEREXPOSED TO IONISING RADIATIONS. Duncan, K. P. (United Kingdom Atomic Energy Authority, Harwell, Eng.); Hill, S. M. B. pp 137-46 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

All establishments where acute external radiation overexposure or significant intake of radioactive materials may occur have to make plans to deal with such situations. Plans for early care and, where necessary, transfer of exposed persons for more specialized care in the United Kingdom are discussed. The factors influencing decisions on the matters are discussed, and the necessary degrees of urgency and precision at various stages of the process are reviewed. All emergency schemes have the objective of guarding against deterioration in the condition of the patient and of preparing him for further definitive treatment. In this respect, the approach to cases of internal contamination is different from that applicable to external radiation exposure. These differences are reviewed and an outline of emergency drill is included for each category of incident. Occupational radiation incidents can be considered as a specialized aspect of occupational health but the planning attention devoted to them has been more detailed than the thought appropriate in other fields of industrial hygiene and safety. The need for a clear distinction in the approach to procedures carried out for the benefit of the patient and those carried out for radiological reasons or research purposes is discussed. (auth)

Radiodiagnosis

Refer also to abstracts 7638, 7724, 7837, 8012, and 8782.

7945 LYMPHOSCINTIGRAPHY WITH TECHNETIUM SULPHUR COLLOID. van Zwol, D. E. (Klinisch-Chemische Laboratorium, Leeuwarden, Netherlands). Nucl.-Med.; 8: 297-300 (31 Oct 1969).

Compared with the scans obtained with radiogold colloid, the scintigrams produced with ^{99m}Tc-sulfur colloid appear to be of an equal quality. The count rate in the adjustment region is not higher than that which can be found when radiogold colloid is used. The great advantage of ^{99m}Tc over ^{198}Au is the fact that the patient receives a much smaller radiation dose from the part of the injected colloid that remains at the site of the injection. According to data from the literature this fraction is about 30 to 50% which, for ^{198}Au, results in a dose of over 1000 rads to the injection site whereas for ^{99m}Tc the dose is only about 10 rads. (auth)

7946 THEORETICAL CONSIDERATIONS CONCERNING MATHEMATICAL MODELS OF RADIOISOTOPE RENOGRAPHY. Doroszewski, J.; Klimasara, A.; Lawruk, B. (Postgraduate Medical School, Warsaw). Nucl.-Med.; 8: 283-96(31 Oct 1969).

A mathematical analysis of theoretical models of the radiohippuran renogram is presented. The preliminary considerations are based on a hydrodynamic model and a diffusion model. On the basis of the model assumptions, the functions describing radioactivity of the blood, kidneys, and urinary bladder are derived. It was demonstrated that by comparing theoretical curves with experimental ones the parameters characterizing some phenomena of hippuran kinetics may be estimated. These parameters are: the clearance of the tracer from the blood, the out-flow of the urine from the kidneys to the urinary bladder, the extravascular diffusion of the tracer, and the functional asymmetry of the kidneys. (auth)

7947 A CRITICAL STUDY OF THE METHOD AND THE RESULTS OF THE RECTAL RADIOIODIDE TEST OF RATZKOWSKI FOR THE DIAGNOSIS OF LIVER METASTASES. Horak, Z.; Dohnalek, J.; Svabenikova, M.; Kadlecova, D. (Purkyne Univ., Brno, Inst. for Oncology, Brno). Nucl.-Med.; 8: 266-74(31 Oct 1969). (In German).

A rectal test using ^{131}I was performed in 69 oncological patients for the diagnosis of hepatic metastases. The results obtained by determining the equilibrium time agreed with the clinical findings in 44% of the cases, were uncertain in 22%, and did not agree with the clinical findings, i.e., they were falsely positive, in 34% of the cases. Though some falsely positive results were subsequently confirmed to be correct it is concluded that the value of this test is not as great as claimed by Ratzkowski et al. According to the results, the sensitivity of the test amounts to 92% but its specificity to only 19%. A dependence of the equilibrium time on the accumulation of radioiodine in the liver or its excretion could not be observed. (auth)

7948 ON SOME PROBLEMS OF USING LOW-ENERGY GAMMA EMITTERS IN SCINTILLATION SCAN TECHNIQUES. Krasznai, I.; Foeldes, J.; Takacs, I. (Medicine Univ. Medical School, Budapest). Nucl.-Med.; 8: 220-31(31 Oct 1969).

Two problems of using low-energy γ rays for scanning are discussed: Model experiments to determine the effect of environmental conditions (tissue scattering) on the quality of scans are described. The scattering is found to affect the quality only for scanners without background subtraction (e.g., spark chambers) because the scattered radiation is not in excess of 5 to 7%, i.e., it is less than the general level of background subtraction (10 to 15%, minimum). Calculations were made to evaluate the applicability of various isotopes (from 28 to 412 keV) to the detection of inactive areas at various depths in thick organs. The optimum energy was found to range from 70 to 150 keV. It is suggested to scan such areas by a new method based on the simultaneous administration of two isotopes. The initial results of this energy-selective isotopic tomography obtained by phantom experiments with ^{125}I and ^{131}I are also presented. (auth)

7949 SCINTIGRAPHY OF SKELETAL DISEASE WITH ^{99m}Tc-IRON(II)-COMPLEX: FIRST RESULTS. Habighorst, L. V.; Schmidt, K. J.; Kutzner, J.; Brod, K. H.; Wolf, R. (Univ., Mainz). Nucl.-Med., 8: 211-19(31 Oct 1969). (In German).

Technetium-99m-iron(II)-ascorbic acid complex was used for the scintigraphic visualization of several diseases of the skeleton, in particular of primary and secondary tumors and of acute and chronic inflammatory processes. First clinical results on 52 patients are reported. Several cases are demonstrated. Kinetic studies indicate that in tumorous or inflammatory processes a real accumulation of the ^{99m}Tc-iron complex takes place that is probably caused by disorders of the blood-tissue barrier. (auth)

7950 METHOD OF PREPARATION OF A ^{99m}Tc–Sn COMPLEX FOR RENAL SCINTIGRAPHY. Charamza, O.; Budikova, M. (Palacky Univ., Olomouc, Czech.). Nucl.-Med.; 8: 301-5 (31 Oct 1969). (In German).

A method for the preparation of a new complex suitable for renal scintigraphy is described. By the reduction of $^{99m}TcO_4^-$ using $SnCl_2$, in the Na-gluconate or -mannonate solution, a ^{99m}Tc-labelled compound is obtained, of which about 40% (applied i.v.) is bound in the liver. The rest of the activity is eliminated quickly through the blood circulation into the urine. This allows scintigraphy one to several hr after the application, with a relatively low activity (about 1 to 2 μCi). The method gives in a short time a high reproducible yield of the material. Its stability allows an application even several hr after the preparation and gives excellent scintigrams of the liver. (auth)

7951 SCATTERED RADIATION IN THE FORMATION OF THE SOFT TISSUE IMAGE. Laval-Jeantet, M.; Aubin, M. L.; Vignaud, J.; Lichtenberg, R.; Korach, G. (Hopital, Paris, Service d'Electroradiologie de la Foundation A. de Rothschild, Paris). Ann. Radiol.; 12: R711-23(1969). (In French).

Measurement of the scattered radiation contributing to the for-

mation of the soft tissue image has been carried out in phantoms of water, animal fat, and biological tissues. In the radiography of low-thickness soft tissues of the the limbs using low-energy radiation, the proportion of scatter in the total amount of radiation reaching the film is low (10 to 30%) whereas with medium energy x rays the percentage may exceed 50%. The low initial contrast of the soft tissue image means that any loss of contrast is particularly undesirable and it is necessary to eliminate it or to limit the scatter. Grids in current use cannot be used below 35 kV and the method of increasing the object-film distance (air-gap) impairs the definition of the image. The only available techniques are limiting the beam using a narrow diaphragm, compression, and the use of the lowest possible energy. A number of practical points can be drawn from these observations. (auth)

7952 ANGIOGRAPHY OF THE HEPATIC SCINTIGRAPHIC LACUNA. Hernandez, Cl.; Morin, G.; Bellin, A. (Hopital Bichat, Paris). Ann. Radiol.; 12: R629-54(1969). (In French).

When the clinical context does not permit easy identification of hepatic scintigraphic defects, angiographic exploration is particularly recommended. It is possible to perform it by studying three different vascular axes by choice:—the afferent and rigid arterial axis by superior mesenteric and celiac selective arteriography—the afferent and limp portal axis by arteriography or direct portography—and last, the efferent and limp cavo-upper-hepatic network by cavo-upper-hepatic phlebography through counter-injection; each of these explorations has its own diagnostic value and its own limits. Defects caused by conformation abnormalities are characterized by a parenchyma always homogenous with clear outlines. The extrahepatic structures, visible on the liver, may be associated or not with the intrusion of the hepatic parenchyma, of which vascularization should be studied after that of the involved tumor. Parasitic defects are essentially due to hydatid cysts that stretch and push back the blood vessels (arterial corbelling, more or less marked venous compression, pseudo-Budd-Chiari clapper mechanism) and show a homogenous space avascular in the parenchyma, and a periadventitial ring. Distomatosis has been studied seldom, tyro-bavarian echinococcus cyst grows in the same way as a cancer slowly infiltrating parenchyma. Inflammatory processes give rather disappointing pictures among benign tumors, angioma, and hemangioma, whose angiographic pictures lead to the distinction of three different types. Malignant tumors often appear very similar to benign ones on phlebograms, and anteriography points out the malignant nature of a tumor and recognizes its type: hepatoma, adenocancer associated with cirrhosis, or secondary cancer. Besides the etiological diagnosis, angiographic exploration reveals the localization and extension of the process and constitutes a valuable vascular map for the surgeons. (C.O.)

7953 THE USE OF RADIOACTIVE IODINE IN THYROID DISEASES ESPECIALLY IN THE RANGOON GENERAL HOSPITAL. Myint, Soe; Hoschl, Radmil (Rangoon General Hospital, Burma). Union Burma J. Life Sci.; 2: 90-7(Jan 1969).

The Radioisotope Department of the Rangoon General Hospital is using as routine tests in the evaluating of the thyroid gland function: the uptake of ^{132}I in two- and four-hour intervals, the uptake of ^{131}I in two, six and twenty-four hour interval, kidney excretion of radioiodine, conversion ratio in twenty-four hour interval and the ^{131}I PB value. The in vitro test of uptake of radioactive triiodothyronine on resin is newly introduced. The advantage of this test is that it is possible to avoid the administration of radioiodine to the patient and therefore it can be used even in pediatric practice. The indications and contraindications of radioiodine tests are discussed. The radiation dose to the patient is calculated. Results of radioisotope laboratory are statistically evaluated and presented in five groups: hypothyroid, euthyroid without goiter, euthyroid with goiter, borderline cases, and thyrotoxic cases. There is a remarkable difference in radioiodine uptake between the group of euthyroid persons with and without goiter. Differences as the result of iodine deficiency, which is probably the principal cause of the endemic goiter in Lower Burma are explained. (auth)

7954 OSSEOUS SCINTIGRAPHY WITH THE AID OF ^{47}Sc AND A SCINTILLATION CAMERA. Basse-Cathalinat, B.; Blanquet, P.; Collignon, G.; Mirande-Iriberry, J. (Hopital Saint-Andre, Bordeaux). J. Biol. Med. Nucl., 3: No. 11, 17-19(1968). (In French).

After considering the physical and metabolic characteristics of ^{47}Ca and ^{47}Sc a process of scintigraphy was proposed in which a scintillation camera was used and 166 keV of ^{47}Sc was placed on the photoelectric peak. The images obtained of the animal show a better definition in relation to that obtained classically with ^{47}Ca or ^{85}Sr. (tr-auth)

7955 ATLAS OF ROENTGENOGRAPHIC MEASUREMENT. SECOND EDITION. Lusted, Lee B.; Keats, Theodore E. Chicago; Year Book Medical Publishers, Inc. (1967). 249p. $11.00.

Techniques of roentgenography are given for the central nervous system, neck, various parts of the skeletal system, respiratory system, cardiovascular system, gastrointestinal system, spleen, adrenal glands, urinary tract, and fetus. Measurements were made on large numbers of normal structures and statistics are presented in the form of tables and graphs. In many cases figures are given for abnormal conditions also. In order to detect pathological conditions the physician must have access to data on the normal range of size and form of anatomical structures of the body; such information is provided by this extremely valuable atlas. A subject index is included. (H.L.W.)

7956 CONCERNING THE IRRADIATION DOSES IN ROENTGENOLOGICAL EXAMINATION IN OBSTETRICS AND GYNECOLOGY. Demidkin, P. N.; Ustinskov, V. I. Vestn. Rentgenol. Radiol.; No. 4, 56-9(Jul-Aug 1969). (In Russian).

The results of dose distribution studies in physico-technical conditions of roentgenography of the pelvis in a paraffin phantom are given. The doses were measured in a water phantom with a bone skeleton placed into it, and in the vagina of the patients. A KID-2 dosimeter was used for this purpose. (auth)

7957 THE SCINTIGRAPHIC EXPLORATION OF THE CEREBRA CISTERNA. TECHNICAL CONSIDERATIONS OF ANATOMIC SCANNING. Signorini, E.; Casamassima, F.; Gainotti, G.; Palumbo, R.; Senin, U. (Univ., Perugia, Italy). Nunt. Radiol.; 34: 911-26(Sep 1969). (In Italian).

Following a review of the limits of fractional encephalography and of ventriculography, which, being inherent to the intrinsic characteristics of these techniques, therefore cannot be overcome, the scanning of the cerebral fluid pathways with radioactive isotopes as a method for solving the problems, unsettled by traditional nerve system roentgenologic means is considered. After having stressed the important role of the characteristics of the radioactive nuclide, the literature is reviewed. On the basis of their clinical experience and of chemical, physical, and biological considerations, they propose ^{203}Hg-Neohydrin as the tracer of choice for cisternal scanning. Problems of dose and ways of introduction, as well as characteristic features of the various observation and registration apparatuses are also discussed. A detailed description of the diffusion patterns of the radioactive compound in the brain cisternae follows, together with a discussion of normal anatomic cisternal scanning pictures in the three essential views, i.e., side, back, and front view. (auth)

7958 THE RADIOISOTOPE DIAGNOSIS AND PATHOLOGY OF THE LINGUAL THYROID. Falcetti, E.; Spina, C. (Univ., Rome). Nunt. Radiol.; 34: 835-54(Sep 1968). (In Italian).

The finding of formations with a typical thyroid structure at the base of the tongue has a very great clinical interest for they reveal a developmental anomaly of this gland and can undergo modifications identical to those of the normal neck thyroid parenchyma. Embryological aspects are outlined, and some cases observed at the Rome University Institute of Radiology are reported. They particularly stress the importance of modern radioisotope techniques for the identification of lingual thyroid tissues, which can no longer be considered as rare. (auth)

7959 NUKLEARMEDIZIN: SZINTIGRAPHISCHE DIAGNOSTIK. (Nuclear Medicine: Scintigraphic Diagnosis). Feine, Ulrich; zum Winkel, Karl. Stuttgart, Georg Thieme Verlag, 1969. 442p. DM 120.-.

Radioisotope scanning is evaluated as diagnostic procedure for various fields of medicine. Routinely applied methods are discussed and findings are documented by more than 500 pictures and diagrams. The first part is devoted to basic principles as to physics, measuring techniques, radiopharmacology, dose calculation, and selection of proper equipment. The second part describes clinical techniques and findings for central nervous system, salivary glands, thyroid, parathyroid, heart and vessels, lungs, liver, spleen, stomach, pancreas, kidneys, lymphatic system, bone marrow, body cavities, and tumors. References are given for each section. Several tables list characteristics of medically important radioisotopes and dose burdens for routine procedures. (H.B.G.)

7960 CONTRIBUTION TO THE SCINTIGRAPHY OF POLYCYSTIC DYSPLASIA OF THE KIDNEY AND LIVER. Clementi, T.; Spina, C. (Univ., Rome). Nunt. Radiol., 33: 1309-26(Oct. 1967). (In Italian).

Anatomic data and diagnostic possibilities of the radiological procedures in the polycystic dysplasias of the kidney and of the liver are reviewed; scintigraphic aspects found in these diseases are described. Scintigraphic examination in polycystic dysplasia of the kidney is useful when radiological examinations are not adequate for an exact diagnosis. In the polycystic dysplasia of the

liver, the scintigraphic method is supplemented by laparoscopy; as a diagnostic tool for polycystic dysplasia of the kidneys, scintigraphy alone is sufficient. (H.B.G.)

7961 NEW IMAGE DISPLAY AND ANALYSIS SYSTEM (IDA) FOR RADIONUCLIDE IMAGING. Natarajan, T. K.; Wagner, H. N. (Johns Hopkins Medical Institutions, Baltimore). Radiology, 93: 823-7(Oct. 1969).

The characteristics and performance of a new image display and analysis system (IDA) that makes possible optimization of the radionuclide images while the observer views the image are described. It permits quantification of various regions of single or multiple images, utilizing the original data. The system has already proved useful in studying patients with pulmonary embolism and in diagnosing cerebral lesions, and it promises to have numerous other clinical and research applications. (auth)

Radiotherapy

Refer also to abstracts 7667, 7735, 7756, 7811, 7924–7928, 8009, and 8010.

7962 (RD/B/N-1445) SURVEY OF EXPERIMENTAL DATA ON DOSE-RESPONSE RELATIONSHIPS. Wright, J. K. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Oct 1969. 16p. Dep. CFSTI (U. S. Sales Only).

The available quantitative evidence on the long term somatic effect of radiation on people is discussed. The facts suggest (a) an almost linear dose-risk relationship for leukaemia at doses between 100 and 2000 rads to the whole spine, (b) a similar response between large single doses given in fraction of a second and doses spread out over several years, (c) a shorter latent period and risk period for leukaemia than for other malignancies, (d) the risk from other malignancies being several times greater than that from leukaemia when the whole body is uniformly irradiated, (e) with the probable exception of leukaemia, the likelihood of producing a particular neoplasm being roughly proportional to that neoplasm occurring naturally in a person of the same age when the whole body is uniformly irradiated. Although the dose-risk relationship for leukaemia is approximately linear between 100 and 2000 rads, there is an indication that the relationship could be a higher power law at lower doses. A possible mechanism leading to this general form of behavior is discussed in the Appendix. (auth)

7963 (UCRL-18806) PHYSICAL AND RADIOBIOLOGICAL ASPECTS OF NEGATIVE PIONS WITH REFERENCE TO RADIOTHERAPY. Raju, M. R.; Richman, C. (California Univ., Berkeley. Lawrence Radiation Lab.). Sep 1969. Contract W-7405-eng-48. 32p. (CONF-691021-2). Dep. CFSTI.

From 12th International Congress of Radiology, Tokyo, Japan.

The production of π mesons and their interaction with tissue is briefly discussed. Physical measurements of depth-dose distribution indicate that the dose at the peak region is 2 to 3 times higher than that at the entrance. LET (linear energy transfer) measurements indicate that at the Bragg peak region a significant portion of the dose is due to high-LET components. Radiobiological measurements at the peak of the depth-dose distribution gave RBE (relative biological effectiveness) values in the region of 2 to 5, depending on the biological end point used. The OER (oxygen enhancement ratio) at the peak is found to be significantly low compared with low-LET radiations such as x rays and γ rays commonly used in radiotherapy. (C.O.)

7964 VARIATIONS OF THE OXYGEN EFFECT INDUCED BY RADIATIONS OF DIFFERENT IONIZING DENSITIES. Silini, G. (CNEN, Rome). Nunt. Radiol., 34: 37-52(Jan. 1968). (In Italian).

From Convention on Hyperbaric Radioisotopes, Florence, Italy. See CONF-670983.

The amount and the weight of previous information assembled up to now concerning the effects of oxygen on the radiobiological action of radiation at various LET's more than justify the present attempts to use clinical radiation at high ionizing densities for the radiotherapy of malignant neoplasms. The time has come when this information, especially that developed within the realm of pure radiological research should pass beyond the theoretical phase into the phase of experimental application, to consider the directions and the limits of the therapeutic use of these radiations. The need to further clarify many obscure points in this phase of the problem will require close cooperation between the clinic and the biologist as in the development of an optimal plan of therapy. (E.R.B.)

7965 RADIOLOGICAL TREATMENT OF GIANT CELL TUMORS OF THE SKELETON. De Marzi, Stefano (Univ., Florence). Nunt. Radiol.; 34: 315-27(Apr 1968). (In Italian).

From literature analysis concerning the giant cell tumors of the skeleton some conclusions are drawn. The radiological treatment gives a percentage of healing of 60%; The radiological treatment associated with curettage reduces the incidence of the recurrences; Many of the damages ascribed to the radiotherapy are to be attributed to treatments performed by very high dosages; the incidence of the malignant change is not so high as reported by some authors and the risk is not so great as to contraindicate the treatment; The radiological treatment is indicated in cases badly accessible to the radical surgery or in those treated by curettage. (auth)

7966 THERAPEUTIC RESPONSE OF INTRACRANIAL HODGKIN'S DISEASE DOCUMENTED BY BRAIN SCANNING. Thompson, Ronald W.; DeNardo, Gerald L. (Stanford Univ., Calif.). Cancer; 24: 981-4(Nov 1969).

Documented cases of intracranial Hodgkin's disease are rare. Most of these cases are demonstrated only at postmortem examination. The case reported herein illustrates effective treatment with electron beam irradiation of biopsy-proven intracranial Hodgkin's disease. Radioisotope scanning using ^{99}Tc-pertechnetate proved to be of particular value both in the original diagnosis of this problem and following the therapeutic response. (auth)

7967 ENDOLYMPHATIC RADIOTHERAPY. A COMPARISON OF RADIOGOLD AND RADIOIODINE AGAINST THE VX2 TUMOR IN THE RABBIT. Lloyd-Davies, R. W.; Edwards, J. M.; Kinmonth, J. B. (St. Thomas' Hospital Medical School, London). Cancer; 24: 938-44(Nov 1969).

Comparison of the radioisotopes of iodine and gold were made by a controlled trial treating lymph node metastases from VX^2 tumor in the rabbit by the endolymphatic route. Control animals received tumor inoculation only, and two further groups received either 4mCi ^{131}I in ultrafluid lipiodol or 8mCi ^{198}Au colloid. The primary tumor was excised at eight to 10 days after inoculation in all animals. Pelvic node weight was the main factor on which the trial was assessed. A significant difference in node weight was found between the treated and control groups, but there was no significant difference between the treated groups. No significant increased incidence of lung metastases was found in animals receiving endolymphatic infusions. (auth)

7968 EXTRACORPOREAL IRRADIATION OF THE CIRCULATING BLOOD. Cionini, L. (Univ., Florence). Riv. Radiol.; 8: 107-20(1968). (In Italian).

A critical review is presented on the use of extracorporeal irradiation of the circulating blood in experimental and clinical fields. The results reported in the literature on the study of the radiosensitivity characteristics of cells of circulating blood, prolongation of the homotransplant acceptance, and therapy of some types of leukemia are reported and analyzed. (tr-auth) (26 references).

7969 TECHNICAL NOTE ON THE NON-RADIOACTIVE PREPARATION OF ^{192}Ir WIRES. Sinistrero, G.; Benedetta, A. (Univ., Turin). Minerva Dermatol.; 42: 540-4(Nov 1967). (In Italian).

After briefly recalling the advantages of using iridium instead of Ra in interstitial Curie's therapy, a technique devised at the Dermatological Clinic of the University of Turin is described. This involves the non-radioactive preparation of iridium. The advantages for patients and operators are discussed. (auth)

7970 COMBINED TREATMENT OF CANCER OF THE CERVICAL ESOPHAGUS BY BLEOMYCIN AND IRRADIATION. Kawata, Seiichi; Soda, Toyoji (Kyushu Univ., Fukuoka). Jibi To Rinsho, 15: 154-67(June 1969). (In Japanese).

Six cases of cervical esophageal carcinoma were treated with bleomycin. The drug was effective even for the advanced cancer. Excluding two cases, four of them are going on well. By administration of bleomycin, the remarkable degeneration and necrosis of the tumor cells were microscopically observed. When the drug was applied during radiation therapy, most cancer cells were destroyed. The combined use of 3000 Rads, ^{60}Co γ radiation and bleomycin was thought to be more effective than irradiation of 6000 to 7000 Rads. In other words, when bleomycin was used during radiation, it seemed to act multiplicatively on the tumor cells. Based on the histological changes of the tumor cells, some cases of the cervical esophageal carcinoma might be cured by the adequate combined treatment of bleomycin (200 to 300 mg) and γ irradiation of ^{60}Co (4000 to 5000 Rads) in tumor dose. Direct injections of bleomycin to the primary tumor or to the metastatic neck tumor through the skin were significantly effective. No favorable result was obtained when bleomycin was given after radiation therapy. Administration of bleomycin produced ill effects such as fever, anorexia, and pigmentation of the skin, but these were not severe. Even in cases treated with the combined method of bleomycin and irradiation, no leukopenia occurred. (NSA of Japan)

7971 RADIOISOTOPE VENTRICULOGRAPHY IN THE ARNOLD–CHIARI MALFORMATION. Castellino, Ronald A.; Zatz, Leslie M.; DeNardo, Gerald L. (Stanford Univ., Palo Alto, Calif.). Radiology, 93: 817-21(Oct. 1969).

Five infants with proved Arnold–Chiari malformation were studied with simultaneous air ventriculography and RISA ventriculography. All five showed blockage to air at various levels, and in no instance was air shown to reach the cerebral convexities. Four of the five infants showed definite flow of RISA over the cerebral convexities indicating patency of the cerebral subarachnoid space, although the rate of flow was markedly slower than normal. A radioisotope tracer is a more reliable indicator of cerebrospinal fluid flow and of patency of subarachnoid pathways than is air. Such studies as these may help elucidate the cause of hydrocephalus in the Arnold–Chiari malformation. (auth)

7972 RELATIVE BIOLOGICAL EFFECTIVENESS OF FAST NEUTRONS FOR MAMMALIAN TISSUES. Field, Stanley B. (Hammersmith Hospital, London). Radiology, 93: 915-20(Oct. 1969).

In order to obtain information about the relative biological effectiveness (RBE) of fast neutrons, an analysis is made of the results from all normal and malignant tissues irradiated on the cyclotron at the Hammersmith Hospital. The RBE for a number of normal tissue end-points varies with the size of dose in a way which can be predicted from cell-survival curves and in general does not vary significantly from tissue to tissue. For most tissues the RBE for this beam of fast neutrons tends to a constant value of about 1.6 as the dose is increased. For injury to the hemopoietic system, the RBE is smaller. For tumors that contain hypoxic cells, the RBE is greater, implying that therapeutic advantage might be gained from the use of fast neutrons. An examination of the gain factors obtained for various systems shows no significant difference when measured for cells in vitro or for tissues in vivo. The gain factors are very similar for cyclotron-produced neutrons of mean energy 6 MeV and for neutrons generated at about 14 MeV, but for neutrons of lower energy the gain factor is slightly larger. (auth)

7973 EXPERIENCE WITH PITUITARY ^{90}Y IMPLANTATIONS IN ADVANCED BREAST CANCER AT INSTITUT GUSTAVE-ROUSSY (SURVEY OF 300 PATIENTS). Juret, P.; Hayem, M.; Estelin, R.; Markovits, P.; Sarrazin, D.; Lalanne, C.; Pierquin, B. (Institut Gustave-Roussy, Villejuif, France). J. Radiol., Electrol., Med. Nucl., 50: 645-54(Aug.-Sept. 1969). (In French).

Results are summarized for 300 patients with advanced breast cancer who were treated with radioinduced pituitary ablation obtained using ^{90}Y implants. The implantation technique is described. The injection of paraffin into the sella turcica reduced the risk of complications induced by irradiation. Radiation doses of 5 to 10 mCi induced complete destruction of the hypophysis in 75% of the patients treated. Subjective improvement was observed in the majority of the patients and the number of bony metastases was greatly reduced when compared with nontreated patients. A relation between blood group of the patient and response to the radiation treatment was observed and the possibility of genetic control of hormonal activity of the pituitary gland is discussed. (C.H.)

7974 THE MEGAVOLT RADIOTHERAPY OF LOCALIZED FORMS OF MALIGNANT LYMPHOMAS. Pavlov, A. S.; Ankudinov, V. A.; Bolotova, N. P. Vestn. Rentgenol. Radiol.; No. 4, 71-80(Jul-Aug 1969). (In Russian).

Acknowledgement of the theory of tumor progress of malignant lymphomas and of the metastatic character of their spread serves as the basis for theoretical substantiation of megavolt radiation therapy of malignant lymphomas—lymphogranulomatosis, reticulosarcomas, and Brill–Symmers' disease. In localized forms of malignant lymphomas the most indicative is a radical program of megavolt radiation therapy. Eighty-five patients with I and II stages of the disease were treated by the radical program; observation period ranged from 1 to 3 yr. 74 of these patients are in a condition of complete remission. Of 85 treated patients, 68 were suffering from lymphogranulomatosis, 13 with reticulosarcomas, and 4 with Brill–Symmers' disease. Taking into consideration possibilities of megavolt radiation therapy today it is considered that treatment of patients with localized forms of malignant lymphomas with cytostatic agents is absolutely unjustifiable. (auth)

Blast and Thermal Effects

7975 DELAYED RADIATION EFFECTS IN ATOMIC-BOMB SURVIVORS. Miller, Robert W. (National Cancer Inst., Bethesda, Md.). Science, 166: 569-74(Oct. 1969).

Since 1948 the Atomic Bomb Casualty Commission (ABCC) has been evaluating the health of survivors of the atomic bombs in Hiroshima and Nagasaki. In a study of about 70,000 children conceived after the explosion, six indicators of genetic damage failed to reveal an unequivocal effect of radiation. Furthermore, this group displayed no evidence of cytogenetic abnormality, in contrast to the increased frequency of complex chromosomal aberrations found among those exposed in utero or at any time during the entire life span. The effect was most pronounced among persons whose exposures occurred when they were 30 yr of age or older. Although a wide variety of congenital malformations were produced in experimental animals by irradiation of the pregnant mother, the only anomaly observed among the Japanese survivors to date was small head circumference associated with mental retardation, the effect being proportionate to the radiation dose. The ABCC study leaves no doubt that whole-body irradiation in sufficient dose is leukemogenic in man. A similar effect following partial-body irradiation was observed among British men given radiotherapy for ankylosing spondylitis. In both studies the effect was proportionate to the dose, the peak occurred about 6 yr after first exposures, and the increase was in acute leukemias and chronic granulocytic leukemia, not in the chronic lymphocytic form of the disease. In the past few years, a high risk of leukemia has been associated with several human attributes and with radiation exposure. These circumstances have in common an unusual genetic feature, though not of a single type. In several studies conducted in the United States or Great Britain, very small doses of x ray were reported to be equally oncogenic whether exposure occurred before conception or during intrauterine life; whether the neoplasm studied was leukemia or any other major cancer of childhood; and whether the study was based on interviews, which are subjective, or on hospital records, which are not. Among the features that argue against a causal relationship are the similarity of results despite the dissimilarity of subject matter and, with regard to radiation before the child's conception, the failure, in a prospective study by ABCC, to find an excess of leukemia in 22,400 children conceived after their parents were heavily exposed to radiation from the atomic bomb. Increases in cancers other than leukemia were recently reported among the Japanese survivors. Twice the normal frequency of lung cancer was found among persons exposed to doses of 90 rad or more, in a study handicapped by failure to demonstrate specificity with regard to histologic type, as in U. S. uranium miners. A report of an excess of breast cancer was based on six cases observed as compared with 1.53 expected among women who were exposed to doses of 90 rad or more. Certain biases, difficult or impossible to avoid, could produce this small excess. Thyroid cancer, on the other hand, does appear to have been induced by radiation, since a dose-response relationship was apparent and the results are consistent with those observed following therapeutic irradiation. Other effects attributable to radiation but relatively small in magnitude were an increase in general mortality, exclusive of death from leukemia, during the first 10 yr after exposure: a statistically significant biologically small retardation in growth and development; infrequent radiation cataracts, none of which greatly diminished visual acuity; and a polychromatic sheen on the posterior subcapsule of the lens of the eye, which caused no disability but was related to radiation dose. (auth)

Radiation Effects on Animals

Refer also to abstracts 7589, 7727, 7740, 7754, 7758, 7924, and 7968.

7976 INFLUENCE OF RADIATION ON THE MEMBRANE CAPACITANCE OF CELLS AFTER IRRADIATION IN MEDIA WITH VARIOUS POTASSIUM CONTENTS. Polivoda, B. I. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya; 9: 488-91 (Jul-Aug 1969). (In Russian).

Postradiation changes in the value of the membrane capacitance (C_m) of SOTs cells and Ehrlich's ascites carcinoma, irradiated in media with various potassium contents, were studied. A nonlinear dependence of C_m of the irradiated SOTs cells on the potassium concentration, correlated with the kinetics of death of the cells, was obtained. As for C_m of the Ehrlich's ascites carcinoma cells, in this case no statistically significant changes were detected in a broad range of radiation doses when the potassium concentration in the medium was varied. (tr-auth)

7977 MICRO-IRRADIATION OF CELL NUCLEI BY ULTRAVIOLET LASER RADIATION. Moreno, Giuliana; Salet, Christian; Bessis, Marcel (Hopital de Bicetre, Val-de-Marne, France). Compt. Rend., Ser. D; 269: 781-2(18 Aug 1969). (In French).

It was observed that small masses appeared when cell nuclei were exposed to laser rays of 2650 A; they did not appear when other sources of radiation were used. The laser was composed

of neodymium, and focalization was accomplished by He–Ne coaxial alignment with the laser. Immediately after irradiation of the KB cells they were fixed for electron microscope examination and sagittal and transverse sections of the cells were made. Irradiation resulted in cytolysis of the cell, visible by phase contrast microscopy; at the site of irradiation a coagulated mass very dense to electrons was observed. At lower doses selective lesions were observed; they consisted of small coagulations about 0.1 μ in diameter distributed over an area of 2 μ. Irradiation of the nucleolus resulted in the formation of small chromatinic coagulations about 0.1 μ in diameter. (H.L.W.)

7978 EFFECT OF VARIOUS DOSES OF IONIZING RADIATION, APPLIED UNDER DIFFERENT TEMPERATURE CONDITIONS, UPON LYSOSOMAL MEMBRANES OF THE LIVER CELLS, IN VITRO. Kalczak, M.; Sieinski, W.; Grochowska, A. (Military Medical Academy, Warsaw). Folia Histochem. Cytochem. (Krakow); 7: 59-62(1969).

The effect of ionizing radiation applied in doses from 500 to 1500 R, under different temperature conditions, upon the permeability of lysosomal membranes of liver cells was studied. The permeability of these membranes for acid phosphatase was found to depend on the applied dose of radiation and the temperature at which the experiments were carried out. (auth) (NSA of Poland)

7979 STUDY OF SOME METABOLIC REQUIREMENTS FOR REPAIR OF SUBLETHAL IRRADIATION DAMAGE. Ashby, Regina Roux; Bonte, Frederick J.; Belli, James A. (Univ. of Texas, Dallas). Radiology, 93: 895-9(Oct. 1969).

Chinese hamster lung tissue cells in culture are capable of repairing sublethal irradiation damage in balanced salt solution and 6 mM glucose. Sodium fluoride, at concentrations not toxic to these cells but known to inhibit glycolysis in many systems, has no inhibitory effect on repair in full medium. Sodium fluoride does, however, suppress repair completely in an environment in which glucose is the only exogenous source of energy. This suppression of repair can be bypassed by the presence of 12 mM alanine, which can enter the TCA cycle beyond the sodium fluoride block upon conversion of pyruvate. It is assumed that a balanced salt solution and an energy source are the minimal metabolic requirements for the repair of sublethal irradiation damage in the Chinese hamster subline used in these experiments. However, this does not rule out the possibility that intermediates in the glycolytic pathway, such as phosphoenol pyruvate, might be required for repair. (auth)

Invertebrates

Refer also to abstracts 7802, 7803, 7809, and 7810.

7980 THE SENSITIVITY TO X-IRRADIATION OF SOME DEHYDROGENASES IN PARAMECIA ADAPTED TO LOW TEMPERATURE. Kovaleva, N. E.; Frenkel, M. A. (Inst. of Cytology, Leningrad). Tsitologiya; 11: 1266-74(Oct 1969). (In Russian).

Using cytochemical method, activities of succinate, lactate, α-glycerophosphate and glucose-6-phosphate dehydrogenases were investigated in irradiated Paramecium caudatum cultivated before and after x irradiation at 4 to 5°C. The ciliates were incubated in a medium containing substrates and Nitro Blue Tetrazolium (NBT) served as an acceptor of hydrogen. Enzymatic activity, as evidenced by the deposition of diformazan, was found in mitochondria and kinetosomes. Irradiation with the dose of 75 kR caused some changes in the pattern of activity. Succinate dehydrogenase activity appeared to be slightly inhibited within the first 8 to 10 days after irradiation: in the irradiated cells the reduction of NBT proceeded slower compared to the control, and, 18 to 20 days following the irradiation, the ciliates did not still show the initial intensity of staining suggesting a reduced enzymatic activity due to irradiation. Lactate dehydrogenase activity was slightly declined only during the first two or three post-irradiation days. By the 8 to 10th day, this activity returned to the control level. The activity of α-glycerophosphate dehydrogenase appeared to be damaged by irradiation stronger than that of lactate dehydrogenase. During the first 8 to 10 days after irradiation the infusoria failed to return to the initial intensity of staining. A total recovery of this activity took place only on the 18 to 20th day of post-irradiation. The activity of glucose-6-phosphate dehydrogenase was lowered during the first two to three post-irradiation days. Within the following post-irradiation days the enzymic activity increased and became even higher than that in the non-irradiated control. (auth)

7981 THE INFLUENCE OF DIFFERENT DOSAGES OF ROENTGEN RADIATION ON THE MORTALITY AND PROPAGATION OF RHAGOLETIS CERASI L. Glogowski, K. (Inst. of Plant Protection, Poznan, Poland). Pr. Nauk. Inst. Ochr. Rosl.; 9: 263-70(1967). (In Polish).

Investigations were carried out to determine the influence of different doses of x rays upon the mortality and reproduction of Rhagoletis cerasi L. The pupae of different stages were irradiated. The more susceptible were those pupae of the autumn formation, more resistant the pupae before eye pigmentation and the most resistant after eye pigmentation, somewhere 4-6 days before the flight. The lowest dosage applied was 2400 R and caused a complete lack of reproductive ability in both the females and males. The imago emerging from the irradiated pupae with the dosage of x rays proceeded in 82% as compared to 95.7% in the control pupae. (auth) (NSA of Poland)

7982 STUDIES OF THE SURVIVAL, GROWTH, AND MORPHOLOGY OF HYMENOLEPIS MICROSTOMA (CESTODA) AFTER TREATMENT OF THE STROBILA IN VITRO WITH 1,4-DIMETHANESULFONYLOXYBUTANE (MYLERAN) AND ETHYL METHANESULFONATE (EMS). Hutzler, Lillian Beatrice. Knoxville, Tenn.; Univ. of Tennessee (1968). 102p.

Thesis.

In order to study the effects of two radiomimetic alkylating agents, Myleran and EMS, on adult cestodes, seven-day-old Hymenolepis microstoma were subjected to 0.175 mM and 0.350 mM suspensions of Myleran and to 2.14 mM, 8.56 mM, and 34.26 mM solutions of EMS as single doses, the former for three hours and the latter for 30 minutes, in vitro. After treatment the worms were transplanted into new mouse hosts. Control groups, exposed only to saline for like time intervals in vitro, were similarly transplanted into mice. After an interval of seven days post-treatment, the hosts were sacrificed and the worms collected for study. These were mounted on slides and examined for morphological variations. On the basis of the structures used for morphological analysis, it was seen that the testes of the pregravid proglottids present at the time of treatment were sensitive to EMS and that testis anlagen in the proliferative neck region were likewise sensitive as was reflected by testis-deletion in the post-treatment strobila. It was also thought that some of the testicular variations reflected an attempt at recovery at the organ level. Metabolic mechanisms for such recovery were postulated and discussed. Myleran proved to be cytotoxic as was shown by an inverse survival-dose correlation. Some mutagenicity of the drug was shown by testis deletion in the strobila grown post-treatment. Testis deletion was found to be the most sensitive mutational response of the worm to the chemicals. It was postulated that this was a genetic mutation and possible mechanisms were discussed. (Diss. Abstr.)

7983 U.V. REACTIVATION OF PROTOZOA. Calkins, John; Griggs, Gaston (Univ. of Kentucky, Lexington). Photochem. Photobiol., 10: 61-6(July 1969).

Tetrahymena pyriformis and Colpoda sp. were x-irradiated and then analyzed for the capacity to repair uv radiation injury. In all cases, the survival of Colpoda after x and uv irradiation was greater than survival after x irradiation alone. Tetrahymena showed an essentially additive effects of x ray and uv radiation. It was suggested that the mechanism for uv reactivation of protozoa was the induction or activation of a repair system by radiation damage or some equivalent stimulus. A multisystems model of response involving triggered repair + nontriggered repair + photoreactivation is suggested for explaining and predicting the behavior of these organisms. (C.O.)

7984 EFFECTS OF X RAYS ON REGENERATION OF THE TARSUS IN AN INSECT. Bulliere, Desire (Domaine Univ., Grenoble, France). Compt. Rend., Ser. D; 269: 898-901(1 Sep 1969). (In French).

Experiments were conducted on seventh and eighth stage nymphs of the cockroach, Blabera cranifer. X rays applied to the extremity of the tibia prevented regeneration of the adjacent tarsus. After subterminal irradiation, the regenerated tarsus was as long as the irradiated zone which was removed from the extremity of the tibia. A graph is presented to show the correlation between the quantity of unirradiated healthy tissue at the extremity of the tibia and the length of the regenerated tarsus. (H.L.W.)

7985 THE EFFECT OF CERTAIN AGENTS ON RADIOSENSITIVITY OF AMOEBA AND ON RECOVERY FROM RADIATION DAMAGE. Skreb, Yvette. Arh. Hig. Rada Toksikol.; 19: Suppl 1, 117-23(1968).

Effects of gamma and ultraviolet radiation on whole and fragmented amoebae (Amoeba proteus) were studied. Both kinds of radiation caused an initial decrease in the quantity of RNA followed by a later increase. Oxygen intake decreased in anucleate fragments, but in nucleate fragments and in whole amoebae it remained at the same level as that of controls. Studies on the effect of actinomycin D resulted in a twofold effect, an increase in radiosensitivity and an inhibition of spontaneous recovery. Experiments on the effects of cooling showed that low temperature partially and

temporarily inhibited the whole metabolism of the cell; therefore spontaneous recovery could occur faster, but only in the presence of the nucleus and entire cytoplasm. The cytoplasmic DNA did not take part in the recovery phenomena. (H.L.W.)

Vertebrates

Refer also to abstracts 7733, 7734, 7736, 7745, 7746, 7750, 7752, 7753, 7757, 7759, 7761–7764, 7766, 7767, 7923, 7927, 7928, 7930–7933, 7935, 7936, 7939, 7942, and 7963.

7986 (AD-691411) COMPARISON OF SURVIVAL TIMES OF MONKEYS AND RATS EXPOSED TO PULSED AND STEADY-STATE REACTOR RADIATIONS. Levich, C.; Seigneur, L. J.; Strike, T. A.; Hansen, J. R. Jr.; Schlaak, J. R. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Feb 1969. 27p. (AFRRI-SR-69-4). CFSTI.

Macaca mulatta monkeys and Sprague-Dawley rats were unilaterally exposed to whole-body doses of gamma-neutron radiations from a TRIGA reactor. Doses of 2075, 4150, and 12,450 rads were used in the monkey studies. Doses to the rats ranged from 9400 to 66,000 rads. The animals were exposed in two ways. The steady-state animals were irradiated at a dose rate of approximately 1000 rads/minute. The other animals were exposed to a single pulse of radiations. The pulse was about 15 milliseconds wide at half amplitude. The average dose rate under the pulse was of the order of 10 to the 6th power rads/second. At doses sufficient to cause death within 2 days the ordering of deaths was significantly different between pulsed and steady-state irradiated monkeys, with the pulsed animals preceding. The mean survival time of pulsed animals was significantly shorter than their steady state counterparts for both species of animals. (auth) (CFSTI)

7987 (AD-691870) RADIOTOXINS: THEIR NATURE AND ROLE IN THE BIOLOGICAL EFFECT OF HIGH-ENERGY RADIATION. Kuzin, A. M. (ed.). Translated from pp 1-293 of Radiotoksiny, ikh Priroda i Rol v Biologicheskom Deistvii Radyatsii Vysokoi Energii, Atomizdat, Moscow, 1966. 316p. (FTD-HT-23-492-68). CFSTI.

The book furnishes theoretical and experimental data on the formation of toxins in irradiated organisms and on the nature and role of radiotoxins in the biological effects of ionizing radiation. The quantitative relationships for the formation of toxins, their chemical nature, and a wide spectrum of their radiomimetic properties have moved the problem of toxins to the center of attention in the study of initial and activation mechanisms of the biological effects of ionizing radiation. The nature and properties of secondary radiotoxins which are formed with radiation sickness are investigated from the point of view of pathogenesis and radiation-disease therapy. (auth) (CFSTI)

7988 (BNL-14116) DAMAGE REGISTRATION AND REPAIR FOLLOWING NEUTRON IRRADIATION. Elkind, M. M. (Brookhaven National Lab., Upton, N. Y.). [1969]. 43p. (CONF-691106-1). Dep. CFSTI.

From Symposium on Neutrons in Radiobiology, Oak Ridge, Tenn.

The effects of fast neutrons on the survival of cultured mammalian cells were studied, with emphasis on factors and mechanisms affecting repair of sublethal radiation damage in cells exposed to single or fractionated doses of low and high LET radiation. Data are reviewed on the effects of age, temperature, stage in the growth cycle, and oxygen content on the survival of Chinese hamster cells, mouse L cells, HeLa cells, and mouse jejunum crypt cells following exposure to single or two-dose fractionated doses of x radiation of various energies, γ radiation, α particles, β particles, accelerated charged particles, or fast neutrons of various energy levels. The influence of LET on damage and repair of the cells is discussed, with emphasis on repair mechanisms expressed at the level of DNA synthesis in the cell. Preliminary conclusions indicate that cells capable of repairing low LET sublethal radiation damage show an increased responsiveness to acute fast neutron exposures. (35 references) (C.H.)

7989 (BNL-14215) CURRENT RESEARCH IN NEUTRON RBE IN MOUSE LENS OPACITY. Bateman, John L.; Snead, Mary R. (Brookhaven National Lab., Upton, N. Y.). [1968]. 20p. (CONF-691106-5). Dep. CFSTI.

From Symposium on Neutrons in Radiobiology, Oak Ridge, Tenn.

A marked dependence of fast neutron RBE upon dose has been confirmed and quantitated in these studies of lens opacification following radiation exposures covering broad ranges of dose of 0.43 MeV neutrons, 250 kVp x rays, and shorter ranges of dose of 14 MeV and 1.8 MeV neutrons. These studies have coupled the advantages of monoenergetic accelerator-produced fast neutrons, precise parallel dosimetry, a markedly radiosensitive biological system, highly refined frequent lens examination and scoring, and a unique data analysis technique. The present report utilizes a simple analytical step to partially obviate a continuing difficulty in analyzing the bulk of the data with the usual dose-response techniques. The validity of this step is confirmed by precise quantitative data from the most recent experiment in which early discrete opacities were actually counted. A probable mathematical relation of 0.43 MeV neutron RBE to 250 kVp x ray dose is presented. Possible similar relations for neutrons of 1.8 and 14 MeV are suggested. (auth)

7990 STUDIES ON NUTRITIONAL MANAGEMENT IN OPERATION. PART 2. A STUDY ON THE INFLUENCE OF 19-NOR-ANDROSTENOLONE PHENYLPROPIONATE ADMINISTRATION ON THE SUPRARENAL GLAND. SECTION 2. CONCERNING ^{3}H-THYMIDINE UPTAKE AND THE CHEMICAL CHANGES IN THE SUPRARENAL CORTEX TISSUE IN THE PRESENCE OF DEGENERATION, ATROPHY, REGENERATION, AND PROLIFERATION. Mizugaki, Hiroshi (Sapporo Medical Coll.). Sapporo Igaku Zasshi; 32: No. 1, 21-41(Jul 1967). (In Japanese).

A continuation of a study of the influence of 19-norandrostenolone phenylpropionate (19 NAPP) on the suprarenal cortex of rats is reported. At the same time, with regard to the relation with prednisolone sodium hemisuccinate, a suprarenal cortex hormone, an investigation was made on the individual cells and the size of the nucleus of the various layers in the suprarenal cortex. Further a histochemical investigation that expresses the changes of the cortex function and the cortex cells, together with radioautography using ^{3}H-thymidine was conducted and the interaction of both hormones and the mechanism thereof was studied. It found that administration of 19 NAPP produced a slight shrinking of cortex cells which recovered after 10 days. In contrast, while the shrinking of cells accompanied by shrinking of the nucleus as produced by predonine administration failed to show a recovery, when 19 NAPP is administered jointly the shrinking in question is less. As reported previously, when normal rats are exposed to whole-body x irradiation, the appearance of localized degenerative lesions in the suprarenal cortex can be prevented by joint administration of 19 NAPP and predonine. This observation was reconfirmed at a histochemical level. It was also shown that pancortical atrophy in rats as produced by predonine administration can be prevented to a certain extent by 19 NAPP. While no great difference was seen in the ^{3}H-thymidine uptake after 19 NAPP administration, the uptake after predonine administration showed high values and the uptake after joint administration of 19 NaPP and predonine was smaller than that after predonine administration. The picture of recovery after pancortical atrophy showed one finding which supports the 2 step centripetal migration which commences from the so-called transition layer or immediately under the covering membrane of the zona glomerulosa. (NSA of Japan)

7991 INVESTIGATION OF THE INJURIOUS EFFECTS OF FRACTIONATED γ IRRADIATION. Oreshkin, I. G.; Rezontov, V. A.; Laptev, A. I.; Khoruzhenko, A. F.; Malakhovskii, V. N. Voenno-Med. Zh.; No. 11, 49-52(Nov 1968). (In Russian).

Groups of dogs were irradiated daily by a ^{60}Co source at a dose rate of 270 R/hr. The length of study was 1 day in control and 30, 60, or 90 days in experimental groups. Daily samples were selected from the groups for each time period to determine the dose causing the death of 50% of the animals. To support the statistical authenticity of the relation studied, the experiment was repeated on rats. Average overall doses of daily γ irradiation used during the study are reproduced in graphic form. On the same graphs are shown the values that were obtained by the Americans Kaplan and Brauno, and also by the Americans Tompson and Torceloto in analogous experiments on mice. (tr-auth)

7992 QUANTITATIVE AND QUALITATIVE DETERMINATIONS OF GAMETOGENESIS AND RADIATION EFFECTS IN THE PRENATAL BOVINE TESTIS. Matschke, George Herman. Knoxville, Tenn.; Univ. of Tennessee (1968). 74p.

Thesis.

The population of germ cells, number of mitotic figures for germinal and supporting cells, and testicular volume were determined in tests from known-age fetuses. Fifty-six males were irradiated with 400 R (air dose to dam) ^{60}Co gamma radiation at ages ranging from 15 to 280 days post-coitum. Seven control and 11 irradiated males were unilaterally castrated at birth. Five control and 38 irradiated bulls were castrated at approximately 10 months of age. The testes were prepared for histological analyses. The overall germ cell population increased from 44 at days 32 to 35 to 12,000,000 at days 151 to 180. Only a slight increase in germ cell numbers was noted from 211 to 240 days until birth (283 days). The mitotic figure index (number of mitotic figures per 50,000 germ cells) was high while the gonad was in the

germinal ridge stage and reached a peak at 36 to 38 days. The index remained high until day 90 and then dropped abruptly during the 91 to 120 day period. Some germinal mitoses were noted throughout the remainder of the prenatal period with a minor increase occurring in the last days preceding parturition. Necrotic gonocytes were noted at days 120 to 150 and their numbers peaked at 241 to 280 days; necrosis, however, never affected more than 1 percent of the population at any given stage in gestation. The germ cell population prior to day 70 was apparently unaffected by irradiation (400 R to dam) but following irradiation at days 80 to 130 germ cell numbers were reduced to about 7% of the control value in testes excised at 3 to 19 days postpartum. In testes removed 10 months postnatally, no damage was observed in testes irradiated prior to day 70, but in testes irradiated during the 70 to 90 day period 69% of the 1200 cross sections observed were sterile. Sterility among tubular cross sections increased to 88% at 91 to 120 days post-coitum, remained essentially unchanged to day 210 and decreased to 20% at 241 to 280 days of gestation. Since 400 R is a near-lethal dose for the dam and since bulls irradiated at a stage of maximum sensitivity produced seven-tenths billion sperm-per-ejaculate, a number well above the 6 million motile sperm required for optimum fertility in artificial insemination, the probability of sterilizing the bull in the prenatal state with a single-acute whole-body dose of gamma-irradiation is low. (TSS)(Diss. Abstr.)

7993 DISTURBANCE OF THE TRANSMISSION OF EXCITATION IN THE AUTONOMIC GANGLION UNDER THE INFLUENCE OF IONIZING RADIATION AND ITS ROLE IN THE REGULATION OF THE INTERNAL ORGANS. Mtskhvegadze, A. V. (Central Scientific Research Roentgenoradiological Inst., Leningrad). Radiobiologiya; 9: 544-6(Jul-Aug 1969). (In Russian).

The influence of induced impulsation, running from the preganglionic fibers of the inferior mesenteric sympathetic ganglion, on the contraction of the wall of the urinary bladder and its tonus was investigated at doses of 800 to 2500 rad under conditions of local irradiation of the ganglion with complete shielding of the entire body of the animal. Increasing the dose led to blockage of transmission of excitation in the ganglion, that in turn reduced the inhibitory effect of stimulation of its preganglionic fibers on the contractile activity of the musculature of the urinary bladder. (tr-auth)

7994 CHANGE IN THE CONTENT OF ADRENALIN AND NORADRENALIN IN VARIOUS TISSUES OF IRRADIATED ANIMALS. Minaev, P. F.; Musagaleva, G. M. (Inst. of Biological Physics, Pushchino-on-Oka, USSR. Inst. of Experimental Biology, Alma-Ata, USSR). Radiobiologiya; 9: 625-8(Jul-Aug 1969). (In Russian).

The influence of whole-body γ irradiation at a dose of 800 R on the content of adrenalin and noradrenalin in the brain, thymus, heart, liver, kidneys, and adrenals was studied in experiments on rats 3, 7, and 14 days after irradiation. In all the enumerated organs, the content of adrenalin and noradrenalin was changed, but the nature of these changes differed. (tr-auth)

7995 INTERPRETATION OF THE RESULTS OF FRACTIONATED IRRADIATIONS. Eidus, L. Kh. (Inst. of Biological Physics, Pushchino-on-Oka, USSR). Radiobiologiya; 9: 584-8 (Jul-Aug 1969). (In Russian).

The existing hypotheses explaining the effect of fractionation of the irradiation of various specimens are discussed. A new explanation of these results is proposed, according to which the effect of fractionation may also be observed in the absence of any recovery from the primary injuries. It was shown that the proposed model explains all the experimentally observed peculiarities of the fractionation curve and permits a new clarification of a number of radiobiological problems (the question of intracellular recovery, the participation of metabolism in it, the nature of the reverse effect of the dose rate, etc.). (tr-auth)

7996 QUANTITATIVE CHARACTERISTICS OF THE INJURIOUS EFFECT OF WHOLE-BODY EXTERNAL BETA IRRADIATION OF RATS. Darenskaya, N. G.; Pravdina, G. M.; Reitarovskii, I. K.; Grammatikati, V. S.; Krushchev, V. G. (Inst. of Biophysics, Moscow). Radiobiologiya; 9: 579-83(Jul-Aug 1969). (In Russian).

A new apparatus, permitting an investigation of radiation effects in the case of whole-body external irradiation of small laboratory animals in a wide range of doses, is described. In experiments on rats the dose versus effect dependences were determined according to the criterion of lethality in the case of whole-body external irradiation. The value of $LD_{18/30}$ was 4.4 krad. Shortening of the average lifetime of the irradiated animals that died within 30 days was observed only at the level of a dose inducing absolute death of the animals. A description of the clinical symptoms of β irradiation of rats is given, and their dependence on the dose obtained was demonstrated. (tr-auth)

7997 SOME LONG-TERM CONSEQUENCES OF THE RADIO-EMBRYOLOGICAL EFFECT. Piontkovskii, I. A. (Inst. of Higher Nervous Activity and Neurophysiology, Moscow). Radiobiologiya; 9: 547-52(Jul-Aug 1969). (In Russian).

Observations were made of 749 Wistar rats (controls and those subjected to the influence of x rays on the 18th day of embryogenesis at doses from 10 to 200 R). The late radioembryological effect (REE) is manifested in a change in the lifetime: in the case of relatively large doses of x radiation, it is shortened by 25 to 40%; the dynamics of the weight gain of the animals in the postnatal period of life are changed. An oncogenic effect is observed, most pronounced in the case of the influence of relatively low doses of radiation. The long-term manifestations of the REE have peculiarities determined by the sex of the animals. (tr-auth)

7998 CHANGES IN ENTEROCHROMAFFIN CELLS AND THE SEROTONIN CONTENT IN THE PRIMARY RESPONSE OF IRRADIATED RATS. Fomina, G. S.; Stetyukha, N. M. (Military-Medical Academy, Leningrad). Radiobiologiya; 9: 518-21(Jul-Aug 1969). (In Russian).

In the first hours after a single whole-body irradiation of white rats with x rays at a dose of 1000 R, a decrease in the serotonin content and number of Kul'chitskiy cells is observed in the mucous membrane of the duodenum, and the serotonin content in the blood increases simultaneously. The largest increase in the number of enterochromaffin cells and in their granularity is detected 24 hrs after irradiation. During the same period there is also an elevation of the serotonin level in the blood and duodenum. (tr-auth)

7999 DECREASE IN THE RADIOSENSITIVITY OF TENCH EMBRYOS (TINCA TINCA L.) AS A RESULT OF PRELIMINARY IRRADIATION. Kulikov, N. V.; Timofeeva, N. A.; Al'shits, L. K. (Inst. of Plant and Animal Ecology, Sverdlovsk, USSR). Radiobiologiya; 9: 637-9(Jul-Aug 1969). (In Russian).

Preliminary irradiation of just fertilized tench roe with the γ rays of ^{60}Co in the dose range from 25 to 100 R increases the survival rate of the prelarvae that hatch and increases their resistance to supplementary radiation influence at a dose of 4 kR. In view of this, it is proposed that the effects of radiostimulation and increase in radioresistance as a result of preliminary irradiation with small doses are regulated by a single mechanism. (tr-auth)

8000 THE USE OF STREPTOMYCIN AND A COMBINATION OF IT WITH CYSTAMINE FOR THE PROPHYLAXIS OF ACUTE RADIATION SICKNESS. Yusipov, V. S. (Military-Medical Academy, Leningrad). Radiobiologiya; 9: 635-7(Jul-Aug 1969). (In Russian).

The influence of streptomycin on the radioprotective effect of cystamine was studied in experiments on mice. A single administration of streptomycin does not influence the survival rate of irradiated mice. In the case of repeated (four-fold) administration of the antibiotic before or after irradiation, the survival rate of the animals is somewhat increased. Simultaneous and repeated administration of streptomycin does not influence the radioprotective activity of cystamine, evaluated according to survival rate, but in the latter case the average lifetime of the irradiated animals is increased. (tr-auth)

8001 SOME QUANTITATIVE CHANGES IN THE SYSTEM OF THROMBOCYTOPOIESIS DURING ACUTE RADIATION SICKNESS. Rudakov, I. A. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya; 9: 617-20(Jul-Aug 1969). (In Russian).

In experiments on CBA mice and August rats, irradiated at doses of 600 and 450 R, respectively, the dynamics of the quantitative changes in the megakaryocytes and thrombocytes were studied at various periods after irradiation. The quantitative changes in the megakaryocyte apparatus of the bone marrow were more profound than the changes in the number of thrombocytes in the blood. The reduction and restoration of the number of megakaryocytes in the bone marrow were slower than the changes in the total number of myelokaryocytes. (tr-auth)

8002 BLOOD AND PLASMA VOLUME DETERMINATIONS IN THE RAT PERFORMED WITH DOUBLE ISOTOPE LABELING AFTER SUPRALETHAL IRRADIATION OF THE WHOLE BODY. Martonffy, Katalin; Gottwald, Gizella (Orvostudomanyi Egyetem Radiologiai Klinikaja, Budapest). Magy. Radiol.; 21: 306-11(Oct 1969). (In Hungarian).

The changes of the blood and plasma volume were examined in Wistar rats, 6 and 60 hours after whole-body irradiation with 1300 and 1000 R. Erythrocytes labeled with ^{51}chromium and isotope dilution method, using human serum albumin labeled with ^{25}iodine,

were applied. It was found that the plasma volume was increased after 6 hours, and after 60 hours it was significantly decreased. (auth)

8003 MODIFICATION OF SALT-SEEKING BEHAVIOR IN THE ADRENALECTOMIZED RAT VIA GAMMA-RAY IRRADIATION. Cullen, Joseph W. (Veterans Administration Hospital, Perry Point, Md.). J. Comp. Physiol. Psychol., 68: 524-9(Aug. 1969).

The adrenalectomized rat has a markedly increased appetite for nontoxic sodium salts. Whether irradiation could be used to approach modifiability in a specific food hunger, and in particular, in the salt-seeking behavior of the adrenalectomized rat, was studied. Since it was already found that salt aversion can be obtained in the rat by pairing ionizing radiation with salt drinking, it was hypothesized that a salt-irradiation-induced aversion might develop in the adrenalectomized rat. The Sprague–Dawley rats were offered a choice of NaCl- or saccharin-containing drinking water and several days later exposed to 100 R/day for three days. The results indicated that pairing 300 R of ^{60}Co irradiation with salt-water drinking will produce salt aversion (inhibition) even under conditions of severe salt need. Although the aversion persisted statistically for about a week, by day 7 the salt-drinking irradiated rats imbibed quantities of salt commensurate with controls. These rats concomitantly gained weight and none died. The results were compared to earlier ones on nonregulatory salt hunger in the adrenalectomized rat. (BBB)

8004 RADIATION EFFECTS ON LYMPHOPOIESIS UNDER CONTINUOUS LOW DOSE RATE EXPOSURE. Fabrikant, Jacob I. (Johns Hopkins Univ., Baltimore). Contract AT(30-1)-3970. Radiology, 93: 887-93(Oct. 1969).

Under continuous irradiation, the lymphoid tissue of the thymus could achieve a near-steady state of cell population at a lower-than-normal level at a dose rate of 45 Rads/day or less by mechanisms of compensatory cell proliferation. Changes in the patterns of lymphoid cell population kinetics indicated that there was some reserve of proliferative capacity as evidenced by the increased cell production rate in each lymphoid cell compartment. The extent, however, to which these changes were due to decreasing the cell cycle time in each proliferating compartment, or the bringing-in of a reserve proliferating cell population, is not as yet clearly understood. Both mechanisms appeared important in maintaining the steady state of lymphopoiesis. There may have been a reduction in mean generation time by a narrowing of the spread of cell cycle times, thereby effectively increasing the proliferation rates in the recognizable precursor compartments. There may also have been an increase in the size of the proliferating population by active recirculation of lymphoid cells and lymphocyte migration to the thymus and by continuous stem-cell and precursor-cell replacement by circulating lymphoid cells. These processes could provide important homeostatic mechanisms of compensatory cell proliferation which determine the rate of cell birth under the stress of continuous irradiation. (auth)

8005 COMPETITIVE REPOPULATION OF LETHALLY IRRADIATED MICE WITH CELLS OF VARIOUS GENOTYPES. Rejzkova, Jana (Inst. of Experimental Biology and Genetics, Prague). Folia Biol. (Prague), 25: 346-53(1969).

Lethally irradiated mice of two parent strains and their F_1 hybrids were induced to recover by means of a curative inoculum of foetal liver cells consisting of equal parts of cells of the same three genotypes. The time course of competitive repopulation of host's spleen and bone marrow by the three cell types (distinguishable in the metaphase by the T6 chromosome marker) showed a higher capacity of the F_1 hybrid cells. This was displayed particularly in the syngeneic hosts but to a lower extent also in the semi-syngeneic (parent-strain) hosts. This higher proliferative capacity of F_1 cells was confirmed in further experiments in which the hybrid component of the mixed curative inoculum was reduced to 5 and 0.5% respectively. A 17-day lasting passage of cells of the three types separately through F_1 hybrid hosts failed to result in some sort of adaptation which might possibly reduce the inferiority of parent-strain cells in their competition with F_1 cells. (auth)

8006 ANALYSIS OF ALLOGENEIC INHIBITION OF THE COLONY-FORMING CAPACITY OF BONE MARROW CELLS. Lengerova, Alena; Zeleny, V. (Inst. of Experimental Biology and Genetics, Prague). Folia Biol. (Prague), 25: 340-5(1969).

It has been demonstrated in previous experiments that bone marrow cells from F_1 hybrids of two H-2 congenic mouse strains are markedly inhibited in their spleen-colony forming capacity (CFC) when injected into irradiated hosts of either parent-strain type. In the present paper the recipients of F_1 cells were radiation chimaeras whose spleen had been repopulated with equal parts of cells of both parental types. The CFC of F_1 cells (of three different genotypes) in such a simulated syngeneic microenvironment turned out to resemble that in a true syngeneic microenvironment. The loss of the inhibitory capacity of the parental components and the complementation of the two parental cell types resulting in an environmental effect equivalent to that of a syngeneic F_1 environment are discussed. (auth)

Man

Refer also to abstracts 7732, 7735, 7756, 7812, 7838, 7853, 7857, 7859, 7863, 7870, 7872, 7882, 7883, 7894, 7896–7898, 7904–7909, 7923, 7928, 7937, 7943, 7944, 7973, and 7988.

8007 (AD–692167) RADIATION EFFECTS IN MAN: MANIFESTATIONS AND THERAPEUTIC EFFORTS. Annual Report, May 1, 1967–April 30, 1968. Saenger, Eugene L.; Friedman, Ben I.; Horwitz, Harry; Kereiakes, James O. (Cincinnati Univ., Ohio. Coll. of Medicine). Apr. 30, 1968. Contract DA-49-146-XZ-315. 52p. (DASA–2168). CFSTI.

Biochemical studies of deoxycytidine are reported as well as immunology, psychological and psychiatric factors, clinical observation of autologous marrow infusion, and computer analysis of hematological data. (auth)

8008 RADIOLOGICAL PROTECTION REPORT. Blake, A. H. (Canada Emergency Measures Organization, Ottawa). EMO (Emergency Meas. Organ.) Dig.; 8: 8-9(Aug-Sep 1968).

The problem of ingestion and inhalation of ^{137}Cs, ^{131}I, ^{89}Sr, and ^{90}Sr into the body either by direct entry or via the normal food chain was considered. Greatest concern was shown for ^{131}I in relation to its serious effects on the thyroids of children. It was agreed that it is necessary to develop some means of dealing with biological recovery or the time-dose problem of radiation hazard. Man does recover from the effects of radiation, but the rate and manner are still largely unknown. The formula developed by Dr. Blair in the U. S. National Committee on Radiation Protection Report No. 29 can no longer be used as a basis for determining biological recovery in humans. There was general agreement that an acute dose of 200 R is the upper limit that will not cause sickness severe enough to require medical care. (Canada)

8009 STATE OF THE PERIPHERAL BLOOD FOLLOWING X-RADIOTHERAPY OF CANCER OF THE MAMMARY GLANDS. Baramidze, T. G.; Dzhanelidze, M. B. Soobshch. Akad. Nauk Gruz. SSR; 52: 827-32(Dec 1968). (In Russian).

During stages I and II of mammary gland cancer, hemograms of the patient before x-radiotherapy reveal essentially no contrast, whereas during stage III, leukocytosis is noted in up to 63% of the cases. In more than one half of the women, the peripheral blood was not subjected to depression when x-ray doses of 2000, 4000, or 6000 R were used. In 12 to 22% of the patients there was observed a reduction of the number of white blood corpuscles as a result of the depression of leukopoiesis by irradiation, and in 22 to 30% of the others, leukocytosis occurred that could obscure the radiation picture. During leukocytosis, the measure of radioinduced depression of hematopoietic tissue was the incidence of leukopenia, in 18 to 20% of the patients toward the end of radiation treatment, eosinophilia began to appear that was usually combined with leukocytosis and lymphopenia. Erythrocytopenia was noted in 41% of the patients at the beginning of irradiation, but by the end of treatment normal indexes of red blood corpuscles appeared. All of this emphasizes the necessity of strict appraisal of hemograms of irradiated patients with the purpose of averting the depression of the hematopoietic processes by x irradiation at the most sensitive time in the individual. (tr-auth)

8010 METASTATIZING THYROID CARCINOMA: DEVELOPMENT OF THYROTOXIC CRISIS AND BEHAVIOR OF IODINATED COMPOUNDS IN THE BLOOD AFTER TREATMENT WITH RADIOACTIVE IODINE OF FUNCTIONALLY ACTIVE METASTASES OF THE LUNGS. Nemec, J.; Bednar, J.; Vana, S.; Soumar, J.; Soutorova, M. (Research Inst. of Endocrinology, Prague). Nucl.-Med.; 8: 275-82(31 Oct 1969).

A case of thyrotoxic crisis caused by the destruction with radioiodine of functionally active pulmonary metastases of a thyroid tumor is described. The toxic symptoms receded spontaneously after mere symptomatic treatment. (auth)

8011 COINCIDENCE OF DISORDERS OF HAIR GROWTH AND FOLLICULAR MELANOGENESIS IN VARIOUS PATHOLOGICAL CONDITIONS. Konstanecki, Wojciech; Kwiatkowska, Ewa; Mazurkiewicz, Walentyna; Zak, Ryszard; Bachurzewski, Janusz; Skocinska, Mariola (Kliniki Dermatologicznej AM, Warsaw). Przegl. Dermatol.; 56: 185-91(Mar-Apr 1969). (In Polish).

Hyperpigmentations in the roots of growing hairs were found in some cases of seborrheic dermatitis, lupus erythematous discoides

and diffuse alopecia of women. Hyperpigmentations in a small percentage of the roots of nongrowing hairs could be demonstrated in few cases of male pattern baldness and diffuse alopecia of women. Large doses of x rays caused hyperpigmentations in the majority of the hair roots. These hyperpigmentations consist of melanin. The significance of these findings for the differential diagnosis of thallium poisoning is discussed. (auth)

8012 ACCIDENTAL RADIOGOLD (^{198}Au) LIVER SCAN OVERDOSE WITH FATAL OUTCOME. Baron, J. M.; Yachnin, S.; Polcyn, R.; Fitch, F. W.; Sturner, W. Q. (Univ. of Chicago. Argonne Cancer Research Hospital, Chicago). pp 399-414 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

The first reported instance of accidental overdosage with intravenously administered radioactive colloidal gold (^{198}Au) given for liver scanning is described. A 73-year-old female with erythremic myelosis accompanied by hepatosplenomegaly received 200 millicuries instead of the intended dose of 200 microcuries. External monitoring on the second day showed 35 mR/h at 1 meter. Total body scanning of the patient without administration of additional isotope revealed high activity and an abnormally extensive reticuloendothelial uptake. Blood activity at that time was 0.04 microcuries per millilitre of whole blood. Estimated radiation dose to the bone marrow was 400 to 500 R and to the liver was 7000 to 8000 R. There were no symptoms of acute radiation exposure. The patient was placed in strict isolation on the fifth day, and surgical scrub precautions were continued until day 63. Supportive care included buffy coat and platelet packs, prophylactic sterilization of the gastrointestinal tract, and, later, androgen and corticosteroids. The expected decrease in peripheral blood lymphocytes, granulocytes, and platelets occurred in the order mentioned. Liver size decreased, but function tests did not deteriorate. There was no difficulty with clinical infection during the granulocytopenic phase. Lymphocytes and, later, granulocytes showed recovery to subnormal levels, but platelets failed to rise above 8000/mm^3 after the 21st day. The patient developed hematuria and purpura, and suffered a terminal spontaneous intracerebral hemorrhage on the 69th day. At post mortem there was evidence of patchy areas of granulocytic and erythroid marrow regeneration, and some extramedullary sites contained isolated clones of young red cell precursors. There were no specific changes in the liver. The lack of effective methods to mobilize or metabolize colloidal gold particles once they are retained by macrophages and the expected biological sequelae due to the radioactivity associated with these strategically trapped particles are discussed. (auth)

8013 MEDICAL INSPECTION AND REGRADING OF WORKERS ACCIDENTALLY EXPOSED TO RADIATION. Faes, M. H. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp 31-40 of Handling of Radiation Accidents. Vienna; International Atomic Energy Agency (1969). (In French).

From Symposium on the Handling of Radiation Accidents, Vienna, Austria. See STI-PUB-229; CONF-690509.

Medical inspection and regrading of workers exposed to radiation at the time of an accident are basically variable according to the seriousness of the exposure. Minor cases need only a check-up at relatively lengthy intervals and regrading does not usually present any great problem. A case of whole-body irradiation involving very high exposure of a lower limb is reported. Problems of medical supervision and regrading are still arising three years after the accident, without it being possible to determine or even foresee a consolidation period. The issues involved are legal, medical, social, and psychological, and also relate to efficiency. The legal aspect of an accident of this kind involves a series of obligations, such as the prolonged inspection laid down in legal instruments, which varies, moreover, with the country. It also includes the jurisprudential aspect, in particular the much-debated distinction between an industrial accident and an occupational disease. The medical aspect of long-term supervision entails a fairly frequent check on the proper functioning of the different systems, with particular stress on blood sampling and genetic tests, including a chromosome examination. The social aspect is particularly important in the event of nuclear accidents. In the case under consideration the accident resulted in total incapacity to work for almost three years, followed by resumption of work on a part-time basis. The long period of isolation of the patient and the anxiety of his family and those around him regarding the possible outcome of the accident are aspects peculiar to serious exposure to radiation. The psychological aspect is furthermore a part of the social aspect. During his period of confinement the patient only comes into contact with a few persons, whereas once he has been discharged from the hospital he is an object of curiosity and publicity that are at times excessive. Regrading that does not involve downgrading entails the application of a well-developed system of rehabilitation. (auth)

Radiation Effects on Plants

Refer also to abstracts 7589, 7731, 7738, 7742, 7743, 7757, 7798, 7800, 7804, 7807, 7808, and 7987.

8014 (BNL-14117) RELATIVE EFFECTS OF FISSION NEUTRON VS. X IRRADIATION OF SEEDS OVER A WIDE RANGE OF GENOTYPES, DOSES, AND MOISTURE LEVELS. Smith, H. H.; Joshua, D. C.; Combatti, N. C.; Thompson, K. H. (Brookhaven National Lab., Upton, N. Y.). [1969]. 28p. (CONF-691106-2). Dep. CFSTI.

From Symposium on Neutrons in Radiobiology, Oak Ridge, Tenn.

The relative biological effectiveness (RBE) of fission neutrons vs. 250 kVp x rays was investigated in seven species of plants by irradiating seeds under controlled conditions varying from 5% moisture to prolonged soaking at 0°C or 27°C. The responses were compared on the basis of five or more criteria measured in plants grown from the treated seeds. The results with seeds irradiated at the same low moisture level can be summarized as follows: Within a single species, the RBE varied inversely with the dose required to produce the different criteria of response. For a single criterion of response, the RBE varied directly with the radiation sensitivity among species selected for wide differences in nuclear volume. As a consequence of the inverse relation of RBE to dose, at 50% damage incurred in two of the more radiosensitive criteria in the three most sensitive species the RBE's ranged from 21 to 32, whereas for the two least radiosensitive criteria in the three least sensitive species the RBE's ranged from 7 to 12. A logarithmic plot of the neutron dose vs. the x-ray dose to produce equal effects showed an approximate linear relationship and a close correlation (r = .95) over four orders of magnitude of neutron dose. The fit was closest for a single criterion (as plant height), measured at different end points (D_{90} to D_{10}), and combined in one plot for a variety of genotypes (six species). The least squares linear regression equation for these points provided a single expression for each criterion of the RBE of neutrons vs. x rays over a wide range of doses. The results with seeds of one species, barley, irradiated at different moisture levels, can be summarized as follows: Dormant seeds irradiated at 5% moisture content gave an REE about half that of seeds with 13% moisture because the latter were more resistant to x rays, but not to neutrons. Seeds hydrated for increasing periods of time (4 to 36 hr soaking) before irradiation became increasingly sensitive to radiation; more so to x rays than to neutrons. This gave a progressive decrease in RBE, from the maximum at 13% moisture content (dry) seeds. Seeds soaked at 27°C gave about twice the reduction in RBE over seeds that were soaked at 1°C in order to minimize metabolic activity. This was because the gain in effectiveness in 36 hr of hydration at 1°C is 2-fold for neutrons and 4-fold for x rays (RBE/2), whereas the comparable gain at 27°C is 6-fold for neutrons and 24-fold for x rays (RBE/4). In a system of increasing radiosensitivity caused by hydration, the RBE decreased with the reciprocal of the dose ($1/D_{50}$), i.e., with increasingly damaging effectiveness; just as in a system of constant sensitivity (seed dried to one moisture level) the RBE also decreased with increasing damage, but directly with the dose. The increase in sensitivity to neutron irradiation with soaking at 1°C could be accounted for by the increase in energy absorbed (MeV/nucleus) attributable to the increase in nuclear size and hydrogen content. (auth)

8015 EFFECTS OF GAMMA IRRADIATION ON RADIATION SENSITIVITY IN THE DIPLOID POTATO SPECIES SOLANUM CHACOENSE. McCrory, G. J.; Grun, P. (Pennsylvania State Univ., University Park). Radiat. Bot.; 9: 407-13(Oct 1969).

The effect of ancestral exposure to radiation on the radiation sensitivity of progeny was tested using the diploid potato species Solanum chacoense f. gibberulosum. Approximately 83 per cent of seedlings of a parental population that received 0 and 3 kR of gamma radiation survived and grew normally, while only 26 per cent of those receiving 6 and 9 kR survived and appeared to grow normally. The survival and vigor of seedlings derived from plants that had survived these doses were compared following exposure to the same doses. The results indicated that radiation damage measured in terms of survival and vigor was increased among most of those plants whose ancestors had received doses of 6 and 9 kR of radiation. This increase was attributed to the hereditary transmission of radiation-induced genetic damage in the form of recessive lethals and detrimentals. Certain lots failed to show increased radiation sensitivity as measured by decreased survival. This result was interpreted as resulting either from chance failure of mutation in the parental plants involved, or to somatic elimination of radiation damage induced in young seedlings. (auth) (UK)

8016 EFFECTS OF CHRONIC GAMMA IRRADIATION ON THE ANATOMY OF VEGETATIVE TISSUES OF PINUS RIGIDA MILL. Bostrack, J. M.; Sparrow, A. H. (Brookhaven National Lab., Upton, N. Y.). Radiat. Bot.; 9: 367-74(Oct 1969).

The growth habit and tissues of Pinus rigida trees, exposed to chronic gamma irradiation for seventeen years, were examined in detail. Macroscopic effects of gamma irradiation include premature leaf fall, stunting of needles and necrosis of terminal buds. Microscopic examination revealed disorganization of active shoot apical meristems, reduced activity of the vascular cambium, and delay in lignification of xylem elements. The influence of gamma irradiation on the vascular cambium initials was evident from the irregular pattern assumed by derivative cells differentiating centripetally in the xylem and from the relatively narrow annual rings. The transition from early wood to late wood was also less evident in irradiated trees because of more uniform cell wall thickness. Shoot apical meristems of irradiated trees exhibited a flattened dome shape with the terminal superficial cells showing the greatest degree of sensitivity. (auth) (UK)

8017 THE RADIATION INDUCED REACTIONS OF PHYCOMYCES BLAKESLEEANUS: PULSED TRANSFER OF CELLULAR PARTICLES. Forssberg, A. (Karolinska Institutet, Stockholm). Radiat. Bot.; 9: 391-5(Oct 1969).

Low X-ray doses, given within a short space of time, initiate a pulsed transfer of particulate matter from the substrate–mycelium zone into the sporangiophores of Phycomyces. This reaction, reminiscent of the radiation response of colloidal suspensions, appears to act as a trigger mechanism for further cellular events. A reversible splitting of cytoplasmic particles, or some fraction therein, was noticed. This effect coincides with the appearance of a transient oxygen deficiency in the sporangiophore. Further consequences of the low oxygen concentration are an increase of free SH-groups and a few minutes later of auxin. (auth) (UK)

8018 NOTES ON HYPERPLASIA INDUCED IN CARROTS BY β-RAYS, DECAPITATION, OR AGROBACTERIUM TUMEFACIENS. Skou, J. P. (Danish Atomic Energy Commission Research Establishment, Risoe). Radiat. Bot.; 9: 397-406 (Oct. 1969).

Sprout-inhibiting doses of γ-rays applied to the whole length of carrots induce a severe increase in storage rot. In an attempt to diminish this β-rays were applied instead to the upper two cm of the fleshy roots. One of the effects was the development of hyperplasia at the root-end in a considerable number of the carrots. These tumor-like structures were compared with hyperplasia developed after decapitation, with the callus formed when one or both ends were cut off the carrots, and with the crown-gall tumors induced by Agrobacterium tumefaciens. Hyperplasia also developed at the root-traces. This was noticed more often after decapitation than after irradiation. Histologically, as well as morphologically, only minor differences were found between the callus developed after cutting off the root-end and the other hyperplasias. The crown-gall tumors contained the same elements, but the tissue was more loose or fragile, faster growing and with a marked tendency to develop secondary roots. The hyperplasia formations were greatest when developed at the root-end, both on whole irradiated carrots and as calluses on carrots that had the root-end cut, and they were always greatest when the carrots were inverted. The irradiated part of the carrots often shrivelled as the hyperplasia developed. This was never seen in carrots without tumors, or in γ-irradiated or untreated carrots under the same conditions of storage, and it may be due to transportation of matter to the locations of the tumors. In spite of the similarity between the different hyperplasias it is still an open question whether they develop as an effect of the physical injury to a system with a high regenerative ability or whether radiation-produced substances may promote an already existing tendency to hyperplastic regrowth. It seems unlikely that the high frequency of hyperplasias in the physically injured carrots should have had its origin in an attack of A. tumefaciens. (auth) (UK)

8019 POSTRADIATION RECOVERY OF PLANTS BY WASHING IRRADIATED SEEDS WITH SOLUTIONS OF UREA. Kuzin, A. M.; Buadze, O. A. (Inst. of Biological Physics, Pushchino-on-Oka, USSR. Georgian Scientific Research Inst. of Agriculture, Tbilisi, USSR). Radiobiologiya; 9: 640-3(Jul-Aug 1969). (In Russian).

The influence of washing irradiated seeds of two varieties of corn with solutions of urea was investigated. It was shown that at irradiation doses producing a 50% inhibition of development, washing the irradiated seeds with a 2% urea solution leads to a restoration of growth, chlorophyll content, proteins, sugars, and peroxidase and polyphenol oxidase activity. The results obtained indicate an important contribution of primary radiotoxins to radiation damage to the developing seed embryo. (tr-auth)

8020 INFLUENCE OF INHIBITORS OF OXIDATIVE AND SUBSTRATE PHOSPHORYLATION ON ATP SYNTHESIS AND THE MAGNITUDE AND RATE OF SUBSEQUENT REPAIR IN YEASTS SUBJECTED TO GAMMA IRRADIATION. Mosin, A. F. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya; 9: 500-5 (Jul-Aug 1969). (In Russian).

In experiments on diploid yeast Saccharomyces vini Megri 139V it was found that incubation of the cells in a medium containing arsenate and dinitrophenol (DNP) leads to a substantial decrease in the ATP level and a sharp deceleration of the synthesis of high-energy compounds in the cells. At the same time, the rate and magnitude of their postradiation recovery is unchanged under the influence of inhibitors of phosphorylation. In eight strains of yeasts (with different ploidy and ability for reactivation), incubated after γ irradiation in the presence of DNP, the survival rate and ratio of forms of inactivation were the same as in the control. It is concluded that the suppression of the synthesis of high-energy compounds in the cells does not prevent postradiation recovery. (tr-auth)

8021 INFLUENCE OF THE RADIATION DOSE RATE ON THE SURVIVAL AND RECOVERY OF YEAST CELLS. Petin, V. G.; Polit, V. (Inst. of Medical Radiology, Obninsk, USSR. Max-Planck-Inst. of Biophysics, Frankfurt am Main). Radiobiologiya; 9: 492-9(Jul-Aug 1969). (In Russian).

It was shown that when yeast cells are irradiated under conditions preventing recovery (4°C), the dose rate (interval studied 47 to 240,000 rad/min) does not influence the inactivation and recovery of the cells. In the case of irradiation under conditions promoting recovery (30°C), the effectiveness of irradiation is lowered only at dose rates of 100 and 47 rad/min, which is explained by recovery during irradiation; moreover, the parameters characterizing recovery during irradiation and in the postradiation period are the same. The value of the irreversible component and rate of recovery in the entire range of dose rates studied does not depend on the dose rate and temperature conditions of irradiation. An equation was obtained for the quantitative description of the process of recovery of yeast cells during irradiation. (tr-auth)

Radiation Effects on Microorganisms

Refer also to abstracts 7727, 7730, 7739, 7741, 7747, 7755, 7805, 7987, 8031, and 8032.

8022 AZOTOBACTER CYSTS: REACTIVATION BY WHITE LIGHT AFTER INACTIVATION BY ULTRAVIOLET RADIATION. Vela, G. R.; Peterson, J. W. (North Texas State Univ., Denton). Science; 166: 1296-7(5 Dec 1969).

Cysts of Azotobacter vinelandii 12837 inactivated by uv radiation were reactivated by white light. This photoreactivation mechanism is not seen in the vegetative cells of the same organism. (auth)

8023 PROPERTIES OF SIMIAN VIRUS 40 RESCUED FROM CELL LINES TRANSFORMED BY ULTRAVIOLET-IRRADIATED SIMIAN VIRUS 40. Kit, Saul; Kurimura, T.; Dubbs, D. R. (Baylor Coll. of Medicine, Houston, Tex.). J. Virol.; 4: 585-95(Nov 1969).

Simian virus 40 (SV40) strains were rescued from various clonal lines of mouse kidney cells that were transformed by uv irradiated SV40. To learn whether some of the rescued SV40 strains were mutants, monkey kidney (CV-1) cells were infected with the rescued virus strains at 37°C and at 41°C. The SV40 strains studied included strains rescued from transformed cell lines classified as good, average, poor, and rare yielders on the basis of total virus yield, frequency of induction, and incidence of successful rescue trials. Four small plaque mutants isolated from poor yielder lines and fuzzy and small plaque strains isolated from an average and a good yielder line, respectively, were among the SV40 strains tested. Virus strains rescued from all classes of transformed cells were capable of inducing the transplantation antigen, and they induced the intranuclear SV40-T-antigen, thymidine kinase, deoxyribonucleic acid (DNA) polymerase, and cellular DNA synthesis at 37°C and at 41°C. With the exception of four small plaque strains rescued from poor yielders, the rescued SV40 strains replicated their DNA and formed infectious virus with kinetics similar to parental SV40 at either 37 or 41°C. The four exceptional strains did replicate at 37°C, but replication was very poor at 41°C. Thus, only a few of the rescued virus strains exhibited defective SV40 functions in CV-1 cells. All of the virus strains rescued from the rare yielder lines were similar to parental SV40. Several hypotheses consistent with the properties of the rescued virus strains are discussed that may account for the significant variations in virus yield and frequency of induction of the transformed cell lines. (auth)

8024 FROM TARGET-THEORY TO MOLECULAR RADIOBIOLOGY. Zimmer, K. G. (Kernforschungszentrum, Karlsruhe, Ger.). Phys. Med. Biol.; 14: 545-53(Oct 1969).

The development of "hit" and "target" theories and their application in radiobiology are discussed. Bacterial virus (phage) and its free DNA are used to investigate the processes occurring in an ionized target. The formation of atomic hydrogen is found to be one of the important consequences of ionizing a dry target and responsible for the appearance of other free radicals which in turn may lead to biologically observable damage in DNA. Atomic hydrogen generated outside phage and DNA can also have the same biological effects in these materials as ionizing radiation. The importance of these studies to "hit" and "target" theory is discussed. (UK)

8025 R FACTORS IMPROVING SURVIVAL OF ESCHERICHIA COLI K-12 AFTER ULTRAVIOLET IRRADIATION. Marsh, Edward B. Jr.; Smith, David H. (Harvard Medical School, Boston. Children's Hospital Medical Center, Boston). J. Bacteriol.; 100: 128-39(Oct 1969).

Two R factors which have the capacity to improve survival of some strains of Escherichia coli K-12 by approximately 60% after ultraviolet light have been identified and characterized. Both are fi^-, but neither produce colicins. The ability to enhance survival can be separated from all other identified R-factor functions. Improved survival does not result from improved excisional capacity, but does require an intact host capacity for genetic recombination. No effects on host cell growth or postirradiation lag were observed. A proposed mechanism of action is described. (auth)

8026 GENETIC ANALYSIS OF RECOMBINATION-DEFICIENT MUTANTS OF ESCHERICHIA COLI K-12 CARRYING REC MUTATIONS COTRANSDUCIBLE WITH THYA. Willetts, Neil S.; Mount, David W. (Univ. of California, Berkeley). J. Bacteriol.; 100: 923-34(Nov 1969).

The rec mutations carried by 20 strains of Escherichia coli K-12 that are defective in genetic recombination and sensitive to uv light and x rays, and whose λ lysogens show spontaneous phage production, were mapped near thyA. In 15 of the strains, the rec mutation fails to complement recB21 but complements rec-22. The other five strains carry a rec mutation that complements recB21 but not rec-22. These mutations map closer to thyA than those that fail to complement recB21. They therefore appear to be defective in a different recombination gene, denoted recC. The order of recB and recC on the linkage map of E. coli K-12 is thyA-recC-recB-argA. (auth)

8027 INACTIVATION OF RUBELLA VIRUS BY GAMMA RADIATION. Kenny, M. T.; Albright, K. L.; Emery, J. B.; Bittle, J. L. (Dow Chemical Co., Zionsville, Ind.). Contract PH 43-66-461. J. Virol.; 4: 807-10(Dec. 1969).

The Gilchrist and M-33 strains of rubella virus exposed in the frozen state to ^{137}Ce or ^{60}Co were inactivated exponentially according to one hit kinetics. There was no difference in the radiosensitivity of the two strains. Experimental D_{37} values for both strains ranged from 1.9×10^5 to 2.9×10^5 rads, and computed radiosensitive molecular weights ranged from 2.6×10^6 to 4.0×10^6 daltons. (auth)

8028 GROWTH OF ULTRAVIOLET-DAMAGED HERPESVIRUS IN XERODERMA PIGMENTOSUM CELLS. Rabson, Alan S.; Tyrell, Sandra A.; Legallais, Frances Y. (National Cancer Inst., Bethesda, Md.). Proc. Soc. Exp. Biol. Med.; 132: 802-6 (Nov 1969).

The growth of uv-irradiated herpes simplex virus was studied in cultures of skin fibroblasts from a patient with xeroderma pigmentosum and compared with growth in WI-38 cells, skin fibroblasts from people with no evidence of xeroderma pigmentosum and in HeLa cells. The irradiated virus grows less efficiently in the xeroderma pigmentosum cells than it does in the other cell lines examined, suggesting that mechanisms for repair of the uv-damaged viral DNA may be deficient in the xeroderma pigmentosum cells. This is consistent with previous observations of others that repair mechanisms for uv-damaged cellular DNA may be defective in skin fibroblasts and leukocytes from patients with xeroderma pigmentosum. (auth)

8029 DOMINANCE OF ULTRAVIOLET RADIATION RESISTANCE IN PARTIAL DIPLOIDS OF ESCHERICHIA COLI K-12. Uretz, Robert B.; Markovitz, Alvin (Univ. of Chicago). J. Bacteriol.; 100: 1118-20(Nov 1969).

Although an F'13 $capR^+$/capR9 strain is nonmucoid and an F'13 capR9/$capR^+$ strain is mucoid, both strains are uv-radioresistant. In contrast, haploid capR9 strains are uv-radiosensitive. Therefore, uv-radioresistance is dominant to uv-radiosensitivity, regardless of whether the $capR^+$ allele is on the chromosome or on the F'13 episome. (auth)

8030 THE INACTIVATING EFFECT OF HYDROXYLAMINE ON E. COLI PHAGES AND THE POSSIBILITY OF REPAIR OF THE RESULTANT DAMAGE. Vizdalova, Milena (Inst. of Biophysics, Brno). Int. J. Radiat. Biol.; 16: 147-55(1969).

The inactivating effect of hydroxylamine on Escherichia coli phages differing in the composition, structure and type of their nucleic acid was followed. It was found that the structure of the appropriate nucleic acid was an important factor affecting the sensitivity of the phages to hydroxylamine. The phages with single-stranded DNA (φX174) and RNA (f2, fr) were highly sensitive to hydroxylamine, whereas those with double-stranded DNA (phages of T series and phage λcb2) were substantially resistant. Lethal damage of the phage induced by hydroxylamine is partially reparable by uv reactivation not only at the phage λcb2 but also at the phage φX174. This indicates that the changes induced by hydroxylamine are partially reversible even in the phages with single-stranded nucleic acid. (auth) (UK)

Radiosterilization and Radiopreservation

Refer also to abstract 7589.

8031 (NYO-3733-4) MICROBIOLOGICAL ASPECTS OF RADIOPASTEURIZED CHICKEN. Phase I. Final Report. Fourth Quarterly Report. Pledger, R. A.; Chen, C. S. (Hazleton Labs., Inc., Falls Church, Va.). 29 Mar 1968. Contract AT(30-1)-3733. 112p. Dep. CFSTI.

Phase I of this program was designed to determine the optimum methods to assess a specific microbial population on chicken. These methods are not to detect the presence of a single bacterium, but rather to determine the ecological relationships among a number of selected microorganisms of public health significance. The methods will ultimately be used on presterilized chicken subsequently inoculated with eight groups or genera of microorganisms, followed by low dose cobalt-60 irradiation (0.0 to 0.7 Mrads) and incubation at different temperatures (30, 40, 50, and 70°F) for various periods of time. The eight microbial groups or genera were specifically selected on the basis of their human pathogenesis or utilization as indicators of fecal contamination or spoilage. These are represented by a psychrotrophic group, Aerobacter, Escherichia, Staphylococcus, Salmonella, Streptococcus, Clostridium botulinum Type E, and Clostridium perfringens. Each group was individually irradiated at sub-lethal doses from 5 to 10 times in the presence of chicken to generate radioresistant populations for use in this program. (auth)

8032 (NYO-3733-7) MICROBIOLOGICAL ASPECTS OF RADIOPASTEURIZED CHICKEN. Seventh Quarterly Report. (Hazleton Labs., Inc., Falls Cuhurch, Va.). 28 Mar 1969. Contract AT(30-1)-2733. 122p. Dep. CFSTI.

Studies were conducted on microorganisms in artificially inoculated and untreated chicken. Data on quantification of various microbial groups and incubation temperatures of chicken treated with 0.1 to 0.7 Mrads of γ radiation are presented in tabular form. Microorganisms studied were: Aerobacter sp., coliforms, Clostridium botulinum, Clostridium perfringens, psychotrophs, Salmonella sp., Staphylococcus sp., and Streptococcus sp. Examination of the technique for Salmonella detection and quantification indicated its inability to detect this organism immediately after low dose irradiation. (H.L.W.)

8033 (NYO-3733-8) MICROBIOLOGICAL ASPECTS OF RADIOPASTEURIZED CHICKEN. Final Report. (Hazleton Labs., Falls Church, Va.). 22 Jul 1969. Contract AT(30-1)-3733. 72p. Dep. CFSTI.

The final evaluation of the experimental, microbiological aspects of both artificially inoculated and natural, untreated chicken is presented. All the data were previously reported in the Fifth, Sixth, and Seventh Quarterly Reports. These data are voluminous in quantity and cannot be repeated herein without creating an extraordinarily large document. The purpose of this report is to present the statistical evaluation of the previously reported values derived by the procedures developed in Phase I of this program. Additionally, the results of botulinum toxin assays are recorded and a subjective evaluation of the odor and appearance of each sample is given. For convenience, an appendix is added in which frequently used abbreviations and certain descriptive information is recorded. (auth)

8034 IONIZING RADIATION IN PURIFICATION OF WASTE WATERS. Del Vecchio, V. (Univ., Rome); Branca, G.; D Arca, S. U. Ing. Sanit. No. 1, 3-17(1968). (In Italian). (RT/PROT (68)15).

Radioactive wastes present, at the present, only a liability in the

nuclear energy balance. The possibility of using these residues in the purification of conventional waste water is considered. The reductions of the total microbe charge and the colon bacilli produced by γ radiation in a sedimented sewage were evaluated. It was found that doses of 30,000 rad produce a microbe reduction of 99% and that with 100,000 rad the reduction is more than 99.99%. The colon bacteria are totally destroyed with doses of 150,000 rad. The irradiation exercises influence on other characteristics of the waste: there was, for example, an increase of BOD_5 up to 25% for doses of the order of a megarad and a total destruction of tensioagents with 100,000 rad. Some possibilities for the development of irradiation units, from radioactive wastes, for the treatment of wastes from hospitals and particular industries were discussed. (tr-auth)

8035 UPTAKE OF OXYGEN IN REFRIGERATED RADIO-PASTEURIZED FISH. Ronsivalli, L. J.; Tinker, B. L. (Bureau of Commercial Fisheries Technological Lab., Gloucester, Mass.). Fish. Ind. Res.; 5: 143-9(Oct 1969).

In cans that contained haddock fillets and that were hermetically sealed at atmospheric pressure, radiopasteurized, and stored at about 0.5°C, the level of oxygen dropped from about 21 percent to about 2 percent within 30 days, at which time the percentage of oxygen was still falling. This decrease in the concentration of oxygen indicates that the atmospheric environment within the cans was conducive to the growth of aerobes, microaerophiles, facultative anaerobes, or anaerobes at various stages of oxygen depletion during the storage. (auth)

8036 RADIATION AND FOOD PRESERVATION. Sutton, H. C. (Inst. of Nuclear Sciences, Lower Hutt, N. Z.). Food Technol. N. Z.; 4: No. 3, 4p(Mar 1969).

The present status of radiopreservation of foods is reviewed and some speculation is offered on future developments. The basic effects of radiation on food products, possible toxic products, economic considerations, safety, and governmental requirements are discussed. (22 references). (C.O.)

8037 PRESERVATION OF FOOD. Horubala, A. Przem. Spozyw.; 22: 188-92(1968). (In Polish).

The progress in work on the industrial application of nuclear energy for the preservation of food was examined. This method of preservation seems to be particularly useful for the sterilization of ham, bacon, bone and fish meal, the pasteurization of fresh fish, the extension of the life of certain vegetables such as potatoes and tomatoes and the radio-disinfection of grain. All these applications have been tested on a laboratory and semi-technical scale, or on the technical scale in the case of potatoes, grain, and fruits. Progress in the installation of the radiation sources and the need for further research mainly because of the health and economic considerations are discussed. (auth) (NSA of Poland)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Refer also to abstracts 7544, 8164, and 8165.

8038 (AECL–3478) MATERIALS RESEARCH AT CHALK RIVER. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Oct 1969. 17p. Dep. CFSTI (U. S. Sales Only). AECL $0.50.

Six articles are presented on nuclear materials research including the study of pressure vessel fracture, high resolution electron microscopy, use of graphite in nuclear fuels, fabrication of experimental zirconium alloy tubing, development of zirconium alloys for high temperature application, and thermal oxidation of metals. (G.M.C.)

8039 (AERE-R–5944(Vol.1)) THE INTERACTIONS BETWEEN DISLOCATIONS AND POINT DEFECTS. PART I. THEORETICAL CONSIDERATIONS. PART II. DISLOCATION PINNING. Proceedings of a Symposium held at Harwell, July 4th–12th 1968. Eyre, B. L. (ed.) (Atomic Energy Research Establishment, Harwell (England)). Dec 1968. 300p. (CONF-680715–(Vol.1)). Dep. CFSTI (U. S. Sales Only). UK 39s.

Eleven of the papers presented at the symposium are included in Volume 1. A separate abstract was prepared for each of three of these papers. Papers for which no abstracts were prepared are concerned with dislocation interactions with point defects, energy of atoms on edge dislocations, interactions of solutes with dislocations, theory of dislocation damping, and behavior of charged dislocations in NaCl. (J.R.D.)

For abstracts of individual papers see: 8149–8151.

8040 (AERE-R–5944(Vol.2)) THE INTERACTIONS BETWEEN DISLOCATIONS AND POINT DEFECTS. PART III. DISLOCATION CLIMB. Proceedings of a Symposium held at Harwell, July 4th–12th 1968. Eyre, B. L. (ed.) (Atomic Energy Research Establishment, Harwell (England)). Dec 1968. 286p. (CONF-680715–(Vol.2)). Dep. CFSTI (U. S. Sales Only). UK 44s.

Eleven of the papers presented at the symposium are included in Volume 2. A separate abstract was prepared for each of four of these papers. Papers for which no abstracts were prepared are concerned with mechanisms of dislocation climb, defects in Al single crystals, effects of oxidation on dislocation climb, specimen damage by electron microscopes, diffusion along dislocations, and creep of Al. (J.R.D.)

For abstracts of individual papers see: 8081, 8121, 8122, and 8152.

8041 (AERE-R–5944(Vol.3)) THE INTERACTIONS BETWEEN DISLOCATIONS AND POINT DEFECTS. PART IV. MECHANICAL PROPERTIES. PART V. GENERAL DISCUSSION. Proceedings of a Symposium held at Harwell, July 4th–12th 1968. Eyre, B. L. (ed.) (Atomic Energy Research Establishment, Harwell (England)). Dec 1968. 258p. (CONF-680715–(Vol.3)). Dep. CFSTI (U. S. Sales Only). UK 34s.

Ten of the papers presented at the symposium are included in Volume 3. A separate abstract was prepared for each of five of these papers. One paper was previously abstracted in NSA as 23: 12372. Papers for which no abstracts were prepared are concerned with interactions between glide dislocations and impurity atoms, velocity of dislocations, interactions between solute atoms and dislocations, and plastic deformation of Cu. (J.R.D.)

For abstracts of individual papers see: 8042, 8043, 8082, 8083, and 8153.

8042 (AERE-R–5944(Vol.3), pp 682-92) THE FLOW STRESS OF CUBIC CRYSTALS CONTAINING LOW-SYMMETRY POINT DEFECTS. Frank, W.; Seeger, A. (Max-Planck-Institut fuer Metallforschung, Stuttgart (West Germany). Institut fuer Physik).

A theory of the flow stress of cubic crystals containing low-symmetry (e.g., tetragonal) point defects or small point defect clusters is outlined. Within the framework of this theory the flow stress may be subdivided into two components: one due to elastic shortrange interactions between moving dislocations and defects on or close to dislocation glide planes, and a second one arising from the induced Snoek ordering of the defects in the stress fields of dislocations (long-range interaction). The model accounts quantitatively for the lower yield stress of alpha-iron containing interstitial impurities, the critical shear stress of alkali halides with divalent cation impurities, and the radiation hardening of electron-irradiated aluminum and copper as well as neutron-irradiated aluminum. (auth)

8043 (AERE-R–5944(Vol.3), pp 803-17) GENERAL DISCUSSION. Eyre, B. L. (ed.) ([Atomic Energy Research Establishment, Harwell (England)]).

Discussions and summaries are presented on kinetics of point defect diffusion to dislocations, behavior of point defects at dislocations, diffusion of point defects along dislocation lines, cluster formation on dislocations, interactions of point defects with loops, and radioinduced creep in fissile material. (J.R.D.)

8044 (ANL–7580) SOME OBSERVATIONS ON PHENOMENA AFFECTING WEAR OF BEARING MATERIALS IN SLIDING CONTACT IN SODIUM AND ARGON AT TEMPERATURES UP TO 1200°F. Sowa, E. S.; Tsao, K. C.; Fiala, C.; Divona, C. J. (Argonne National Lab., Ill.). Jul 1969. Contract W-31-109-eng-38. 24p. Dep. CFSTI.

Vee blocks of bearing materials such as Type 304 stainless steel, Clarite T-1, Stellite 19B, and molybdenum, were installed in a modified Falex machine and loaded (75 lb) against Carboloy 78B shafts rotated at 20 rpm for 2-hr periods in static sodium and argon at 300, 500, 700, 900, and 1200°F, respectively. Use of Carboloy shafts restricted wear to the vee blocks. A generalized equation was developed and simplified in an attempt to establish a parametric relationship of the variables affecting the relative wear of these materials. Variations in values of the wear coefficient and a constant reflected the interactions between the vee block-shaft assemblies and the test environments. Plots of volumetric wear versus time are presented to show the effects of sodium lubrication, wetting, and formation of oxide coatings on wear of Type 304 and molybdenum at various temperatures. Retention of MoO_3 as molybdate for molybdenum in sodium results in marked improvement in wear resistance over identical specimens in argon. Recordings of drive-motor current input superimposed above wear plots of Type 304 and Stellite 19B show a correlation between time variation in friction coefficient in regions of abnormal wear and a more stable value in regions of normal wear. (auth)

8045 (CONF-670533) TECHNICAL PAPERS OF THE 21st METALLOGRAPHIC GROUP MEETING HELD MAY 10–12, 1967, BROOKHAVEN NATIONAL LABORATORY, UPTON, NEW YORK. Roman, Harriet Roth (comp.) (General Electric Co., Lynn, Mass.). 262p. Dep. CFSTI.

Twenty-one papers were presented at the meeting. Nine papers were abstracted previously in NSA as 22: 8805, 22: 8249, 21: 30977, 21: 30980, 21: 36877, 21: 39287, 21: 43625, 21: 43626, and 21: 43681. A separate abstract was prepared for each of the remaining twelve papers. (J.R.D.)

For abstracts of individual papers see: 8069, 8070, 8124–8127, 8156, 8157, and 8197–8200.

8046 (UCRL-Trans–10391) STRENGTH OF METALLIC MATERIALS UNDER HIGH PRESSURE. Nishihara, Masao. Translated by J. Byron for Univ. of California Lawrence Radiation Lab., Livermore, from pp 167-8 of Ninth Symposium on High Pressure, Chemical Society of Japan, Nagoya, Oct. 5–7, 1967. 7p. (CONF-671088–1). Dep. CFSTI (U. S. Sales Only).

Data on the effects of hydrostatic pressure on yield and ductility of metallic materials are summarized and discussed. The effects of temperature on materials under high pressure are considered. The summary is primarily concerned with the high pressure phenomena in which brittle materials become somewhat ductile and ductile materials increase in ductility. (J.R.D.)

8047 LASERS IN HIGH TEMPERATURE RESEARCH. Bernal G, E.; Ready, J. F. (Honeywell Corp, Research Center, Hopkins, Minn.). Pure Appl. Chem., Suppl.; 133-57(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

Various types of lasers and their performance in production of high temperatures are discussed. Calculations for laser-induced metal heating are included and laser uses in welding and machining are described. Radiation from laser-exposed surfaces is discussed along with research on gas-breakdown production of high-temperature plasmas. Thirty-seven references are included. (J.R.D.)

8048 HIGH TEMPERATURE RESEARCH INTO PROPERTIES OF MATERIALS. Sheindlin, A. E. (High Temperature Inst., Moscow). Pure Appl. Chem., Suppl.; 1-22(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

Research on high-temperature properties of materials and problems related to high temperature techniques are reviewed. Information is included on thermophysical properties of solids

at high temperature, properties of alkali metals, thermal conductivity of gases, and properties of low temperature plasmas. (J.R.D.)

8049 MATERIALS PROBLEMS IN HIGH-TEMPERATURE NUCLEAR REACTORS. Bowman, Melvin G. (Los Alamos Scientific Lab., N. Mex.). Pure Appl. Chem., Suppl.; 23-35(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

The unique materials problems in the high-temperature nuclear reactors now under development for rockets are related to requirements such as that the fuel element must contain fissionable material and it must be fabricated in a geometry which permits the transfer of heat to the hydrogen propellant. The reactor may contain a moderating material or materials, however, the bulk of the reactor should be composed of materials with relatively low cross sections for neutron capture. Results of survey indicate that an active and relatively successful technology for the fabrication and use of a few materials has been developed. It is not clear that the existing technology has been optimized. The most pressing materials problem is the need for accurate fundamental data which will permit an evaluation and optimization of current technology and, possibly, suggest the path to advanced technology. (auth)

Corrosion and Erosion

Refer also to abstract 9126.

8050 (BNL-14211) INTERACTION EFFECTS BETWEEN DISSIMILAR METALS IN HIGH VELOCITY SODIUM AT TEMPERATURES UP TO 760°C. I. MASS TRANSFER OF VANADIUM ONTO TYPE 321 STAINLESS STEEL. Romano, A. J.; Wachtel, S. J.; Klamut, C. J. (Brookhaven National Lab., Upton, N. Y.). [1968]. 12p. Dep. CFSTI.

Comparative corrosion studies were carried out with potential fuel cladding materials for advanced Liquid Metal Fast Breeder Reactors. The materials under test at temperatures as high as 760°C include refractory metal-base, cobalt-base, and iron-base alloys. Two pumped loops, made entirely of stabilized stainless steels, were used in the investigations. The corrosion specimens were exposed to high velocity sodium (22 ft/sec) in a 24''-long rising temperature region (between 710° and 760°C). In the tests, the oxygen content of the sodium was controlled over the range from <1 to 15 ppm. Post-test examination showed dissimilar metal mass transfer. In tests containing V-base alloys, significant amounts of V were detected on the surfaces of type 321 stainless steel specimens. X-ray fluorescence analysis shows that about 25 times more V was present on the surface of an exposed sample than on an unexposed standard. Microprobe analysis of two type 321 SS specimens that were exposed simultaneously throughout the entire run but at opposite ends of the test section, i.e. 710° vs 760°C, showed that the difference in their corrosion behavior was the depth to which the V penetrates each sample, not the surface concentration of V. In general, increased temperature, exposure time and oxygen concentration in the sodium appeared to increase the extent of dissimilar metal reactions. (auth)

8051 (BNWL-1237) CORROSIVENESS OF PUREX HIGH-LEVEL WASTE SOLUTIONS. Maness, R. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov 1969. Contract AT(45-1)-1830. 13p. Dep. CFSTI.

The effects of Purex Process changes on the corrosion of 304L stainless steel and Uranus S alloy were studied. These changes would reduce the Fe(III) and Al(III) content of waste solutions from 25 to 80% and the sulfate content from 75 to 100% of current flowsheet values. These changes apply to waste solutions produced during the processing of both aluminum-clad fuels (IWW solution) and Zircaloy-clad fuels (ZWW solution). The composition of high-level waste solutions after sugar denitration (PAW and ZAW solutions) would also be affected by the proposed changes. The investigation showed that the corrosion of 304L in IWW solution was not affected greatly by the proposed compositional changes. The most corrosive composition evaluated (no sulfate and 50 percent of the flowsheet value of Fe(III)) was only 50% more corrosive (9.5 vs 6.4 mils/mo) than the current composition. All proposed compositional changes adversely affected 304L corrosion in PAW solution. However, the most corrosive composition evaluated (no sulfate and 50% Fe(III)) corroded 304L at a rate of only 1.8 mils/mo. Current ZWW solution corroded 304L at a rate of 13 mils/mo, whereas the corrosion rate in solutions containing no sulfate, 20% of the flowsheet value of Fe(III) and 0.0 and 20% Al(III) was only one mil/mo. The decrease in corrosion was the result of a decrease in nitrate concentration. The corrosion rate of 304L in current ZAW solution was 1.7 mils/mo. Decreasing the total nitrate concentration by reducing the ferric nitrate and/or aluminum nitrate concentration decreased corrosion. The corrosion rate in the solution containing no sulfate, 20% Fe(III) and 20% Al(III) was only 0.3 mil/mo. Limited data indicate corrosion of Uranus S alloy responded to the compositional changes in the same manner as that observed for 304L. However, the magnitude of the corrosion rates was somewhat lower. (L.C.L.)

8052 (COO-2018-5) STRESS CORROSION CRACKING OF Fe-Cr-Ni ALLOYS IN CAUSTIC ENVIRONMENTS. Period Covered: April 16, 1969-July 15, 1969. Staehle, R. W. (Ohio State Univ. Research Foundation, Columbus). Contract AT(11-1)-2018. 8p. Dep. CFSTI.

The susceptibility of Cr-Fe-Ni alloys to stress corrosion cracking in caustic environments was studied. A prototype cell for stress corrosion tests in boiling NaOH solutions was constructed. It operated satisfactorily in preliminary tests. A prototype cell for polarization measurements in caustic solutions was constructed and awaits testing. (L.C.L.)

8053 (FEI-119) INTERACTION OF BORON AND CARBIDE WITH AUSTENITIC CHROME-NICKEL STEEL IN A SODIUM MEDIUM. Smirnov, V. P.; Bespalov, A. G.; Zolotukhin, B. N.; Pavlinov, L. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1969. 24p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The interactions of boron carbides with steel were investigated with the following results. Boron carbide does not react with austenitic chrome-nickel steel upon immediate contact and in the presence of an air gap at temperatures to 880°C and time duration to 5000 hr. Given a sodium layer between the boron carbide and steel, a reaction occurs which forms the borides Me_2B, $(Cr,Ni,Mo)_2B_3$, or $(Cr,Ni,Mo)_5B$, Me_4B_3 or Me_5B_4, or Me-Mo, Cr, Ni, Fe. The formation of borides results in the redistribution of steel components expressed by reduced iron and nickel concentrations and an increase in the chromium concentration at the boundary of the boride phase in the steel. The temperature dependence of the rate of increase of the boride phase may be represented by the equation: $x^2/t = 1.8 \times 10^{-5} \exp(-21000/RT)$ in cm^2/sec. The reactions of pure boron and boron carbides are identical. During boron contact with steel, borides are also formed, and at a rate of increase in the boride phase as expressed by the above equation. The reaction of boron carbide with steel in the presence of a sodium layer can be decreased significantly by using a protective chromium covering on the steel. The indicated reaction of steel with boron carbide in a sodium medium does not affect the mechanical properties of a steel shell except for a slight decrease in plasticity. (tr-auth)

8054 (GEAP-13539) SODIUM TECHNOLOGY DEVELOPMENT PROGRAM. MASS TRANSFER INVESTIGATIONS IN LIQUID METAL SYSTEMS. Quarterly Progress Report No. 10, June-August 1969. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation). Sep 1969. Contract AT(04-3)-189. 36p. Dep. CFSTI.

Chemistry control experiments were completed during operation of Loops 8 and 9 during the quarter. On-line instrumentation, sampling, and impurity monitors were operated to correlate impurity concentrations with cold trap and plugging temperatures. Cold trap temperatures were varied in the range 300 to 550°F and corresponding response noted for the oxygen meter, distillation sampler, and a hydrogen diffusion cell. These tests were carried out with the loops operating at 1300°F T_{max} and cold leg temperatures of 800°F. The plugging meter was also used to monitor the effects of injection of a small quantity of water in the cover gas with the loop isothermal at 600°F. The characteristics of deposits in the cold leg of a sodium loop are the basis for the conclusion that particulates are nucleated in the main stream and subsequently deposited on surfaces. Distinct pictures of surface deposits of crystallite particles, 2 to 5 microns in size, have been obtained by a scanning electron microscope technique. Sodium samples taken routinely from operating loops showed total alkalinity values of ~10 ppM. Analysis for major elements showed average values for nickel 1.5 ppM, iron 6.2 ppM, and chromium 3.8 ppM. The oxygen meter continued to show correct qualitative response to changes in the impurity level of the sodium. Departure of meter response from the theoretical curve indicates an interaction between oxygen and other impurities such as hydrogen or carbon, especially at 10 to 30 ppM levels of oxygen. The meter response to impurity changes was rapid and reproducible but, for the absolute measurement of oxygen activity, there are serious discrepancies still to be reconciled. Analysis results of particulate residue collected from Loop 1 showed the major metallic elements present to be silicon, manganese, chromium, iron, nickel, calcium, and aluminum. Metallographic and x-ray examinations of water insoluble fractions showed the particles to be complex agglomerates containing both metallic and nonmetallic components. The major phase found by x-ray was alpha iron. An austenitic phase and carbides ($M_{23}C_6$ and M_7C_3) were also detected. Examination

of corrosion data for Types 304, 316, 347 stainless steel and Incoloy-800 obtained in 1300°F sodium to 4838 hours showed a nonlinear response for the alloys with higher corrosion rates. Incoloy-800 exhibited the highest initial and steady state corrosion rate. Type 316 stainless steel continued to show a linear response with the lowest overall corrosion rate. (auth)

8055 (MSAR-69-178) THE EFFECT OF HIGH TEMPERATURE SODIUM ON THE MECHANICAL PROPERTIES OF CANDIDATE ALLOYS FOR THE LMFBR PROGRAM. Quarterly Progress Report, April-June 1969. Kirschler, L. H.; Hiltz, R. H.; Rodgers, S. J. (MSA Research Corp., Evans City, Pa.). Oct 1969. Contract AT(11-1)-765. 86p. Dep. CFSTI.

Creep-rupture testing of Type 304 and 316 ss samples was continued under Loop 3 operating conditions: low oxygen (less than 10 ppM) sodium, liquid flow velocity of 20 ft/sec across the test specimen, and a system ΔT of greater than 70°F. Creep-rupture testing of stainless-steel samples in 1200°F air also was continued. Tests were completed for samples previously conditioned in the 1200 and 1400°F helium-high oxygen sodium excursions. In general, all the mechanical property data are being tabulated, correlated by appropriate mathematical relations, and subjected to computerized programs. Creep-rupture testing of Type 304 and 316 ss samples under the Loop 3 operating conditions described above under Task 1 completed the objectives of this task. Data correlations are in progress. Tensile tests in air and creep-rupture testing under Loop 3 conditions of 10,000-hour helium and "clean" sodium-exposed specimens are in progress. Longer term (>10,000 hours) exposure is continuing. The 500-hour excursion of as-received 304 and 316 ss in high oxygen-sodium has been completed. The 1000-hour excursion of as-received 304 and 316 ss in high carbon-sodium has been completed. Tests to characterize these excursions are in progress. The exposure of the $2\frac{1}{4}$ Cr-1 Mo (standard) material in sodium was continued. Specimens having been exposed 10,000 hours will be removed from the retort early in the next report period. The vanadium alloys (Vanstar-7, -8, -9, V-15 Cr-5 Ti, and V-20 Ti) have been received and machined into test specimens. A temporary hold has been placed on this task. The U. S. S. 18-18-2 alloy has been included for further study under Phase II. A linear variable differential transformer has successfully operated in excess of 1000 hours in 1200°F sodium. Minor read-out difficulties were experienced. New coils are being fabricated for further testing. Calibration and programmatic use of TPE-1-293 and TPE-1-252 oxygen meters in Loop 3 continued. Both meters were proven to be sensitive to ambient temperature changes. An ambient-temperature-control system has been designed and installation is now in progress. A minor cold-trap temperature excursion (250 to 350°F) was undertaken in Loop 3 to provide additional calibration data for TPE-1-252 cell. Precision of analysis at this low oxygen level has prevented precise calibration of the cell. Ambient temperature effects on this cell were confirmed. Ambient-temperature effects on TPE-1-293 cell were also confirmed. A high-temperature operation was conducted at 700°F for 90 hours in preparation of transferring this cell, once calibrated, to Loop-1. This cell fractured during transfer operations. The TPE-1-294 cell fractured during initial insertion into the meter housing in Loop 1. No operational data were obtained. Additional carbon meter calibration data at relatively low carburization rates were obtained in this quarter. The carbon meter was utilized to establish desired carburization levels for the carbon-oxygen synergistic excursion. A least-square calibration curve including all tab data to date was completed. In relation to calibration, there also were further studies involving the correlation of carbon-meter values, analysis of carbon and carbon compounds in sodium samples and plugging-indicator results. (auth)

8056 (N-69-11038) FUNDAMENTALS OF THE OXIDATION PROTECTION OF COLUMBIUM AND TANTALUM. Semiannual Report, April 1-October 1, 1968. Kolodney, M.; Graff, R. A. (City Coll., New York). 24p. (NASA-CR-97999; SAR-6). CFSTI.

Thermochemical data are presented for the silicides, and the protection of both coating and substrate by the protective glass formed during oxidation was investigated. Under certain conditions of temperature and pressure this glass does not form and the coating fails. The study of glass structure and growth is aimed at understanding the causes of failure and providing a rational basis for improving coatings. Since coating life may be limited by the formation of intermediate phases between the silicide and the substrate, these interactions are being investigated along with the efficacy of diffusion barriers to retard intermediate phase growth. The free energies of formulation of the tantalum silicides were determined. Fabrication of $TiSi_2$ specimens was improved and new oxidation rates determined. Oxide films were examined by infrared spectroscopy, x-ray diffraction and electron microscopy. Growth rates of intermediate phases in a number of diffusion couples were measured. (auth) (STAR)

8057 (ORNL-TM-2724) COMPITABILITY OF MOLYBDENUM-BASE ALLOY TZM WITH LiF-BeF_2-ThF_4-UF_4 (68-20-11.7-0.3 MOLE PERCENT) AT 1100°C. Koger, J. W.; Litman, A. P. (Oak Ridge National Lab., Tenn.). Dec 1969. Contract W-7405-eng-26. 16p. Dep. CFSTI.

The TZM alloy (Mo-0.5% Ti-0.08% Zr-0.02% C) showed a very small amount of attack by the fused fluoride salt (LiF-BeF_2-ThF_4-UF_4, 68-20-11.7-0.3 mole %) at 1100°C for 1011 hr. Corrosion manifested itself as leaching of titanium and possibly zirconium from the alloy. The TZM alloy exposed to the salt partially recrystallized, while that exposed to the vapor did not. This recrystallization was attributed to the removal of titanium and zirconium. On the basis of this single test the magnitude and mechanism of corrosion indicate no serious problems for long-term use of TZM in the vacuum distillation processing scheme for the Molten Salt Breeder Reactor. However, the strength properties of the TZM alloy would approach those of unalloyed molybdenum as salt exposure time increased; this is not considered a problem now. (auth)

8058 (SWRI-1228-P-9-16) EXAMINATION OF UPPER LIQUID LEVEL LINE FROM ELK RIVER REACTOR. Burghard, H. C.; Norris, E. B.; Wylie, R. D. (Southwest Research Inst., San Antonio, Tex.). 27 Feb 1969. Contract AT(11-1)-1228. 22p. Dep. CFSTI.

A section of the upper liquid level piping from the Elk River Reactor was examined to determine the extent and nature of the problem which resulted in a primary system leak. Three cracks were located and were identified as being intergranular in nature. They appeared to have initiated on the ID surface and were probably caused by a stress corrosion mechanism. No evidence of cracking was found in the field installed pipe coupled to the cracked nozzle extension. (auth)

8059 DEPOSITION OF CORROSION PRODUCTS FROM AN AQUEOUS STREAM. Kabele, Thomas Joseph. Rochester, N. Y.; Univ. of Rochester (1969). 150p.

Thesis.

The mechanism by which corrosion products in an aqueous stream deposit on the walls of a pipe was studied using a radioactive tracer technique. Irradiated corrosion products were released from a mild carbon steel source to a variety of pipe-wall surfaces immediately down-stream. The fluid stream was aerated, distilled water at 140°F with a Reynolds number in the range 5,280 to 27,220. Experimental data consisted of measurements of deposited activity as a function of position. A mathematical model of the deposition process based on a particulate agglomeration theory was developed. The amount of deposited radioactive corrosion products as a function of position was strongly dependent upon the shear rate in the fluid near the wall. This exactly paralleled the dependence on shear rate of the particle agglomeration theory. (Disser. Abstr.)

8060 HIGH-TEMPERATURE METALLIC OXIDATION. Levine, H. S. (Sandia Lab., Albuquerque, N. Mex.). Pure Appl. Chem., Suppl.; 697-705(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

An extension of Wagner's parabolic oxidation law for single oxide phases for use in models of high temperature behavior of systems that form co-existing oxide and oxygen alloy phases is proposed. The same general mechanism used to describe the growth of a single oxide film is hypothesized for the growth of each phase with the system subject only to additional mass and energy conservation requirements at each planar interface. This description is applicable to very high temperatures. (J.R.D.)

8061 KINETIC STUDIES OF THE ATTACK OF REFRACTORY MATERIALS BY OXYGEN ATOMS AND CHLORINE ATOMS. Rosner, Daniel E.; Allendorf, H. Donald (AeroChem Research Labs., Inc., Princeton, N. J.). Pure Appl. Chem., Suppl.; 707-19(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

Kinetic data on the attack by atomic oxygen and chlorine on Mo, W, C, and B are presented. Experimental techniques are described which were used to establish conditions such that the reaction products volatilize at a rate sufficient to leave the reaction surface unprotected. Atom production methods are discussed. (J.R.D.)

8062 IRRADIATION-INDUCED PRECIPITATION IN A NIOBIUM-STABILIZED STAINLESS STEEL. Shepherd, J. P. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). Metal Sci. J.; 3: 229-34(Nov 1969).

A study was made of the way in which high-temperature neutron irradiation modifies intragranular precipitation processes in a 16 Cr-12 Ni-1 Nb steel. Both matrix and stacking-fault NbC

particles precipitated during irradiation but not during thermal ageing at the irradiation temperature; the amount and type depended critically on the preirradiation heat-treatment. After a solution-treatment and irradiation, the matrix precipitate density generally increased near incoherent boundaries, but when the steel was aged immediately after solution-treatment and then irradiated a precipitate-free zone formed at each side of the boundaries as a result of solute denudation. Matrix precipitation was not observed in the unirradiated control specimens. It is apparent that irradiation-produced vacancies are important in facilitating the nucleation of matrix NbC precipitates, provided that the solute supersaturation is sufficiently high. Although irradiation enhanced the nucleation of stacking-fault NbC, its presence was confined to material with a solute concentration much higher than that required for matrix precipitation. The irradiated specimens were always stronger than the thermal controls and this difference was greatest when both matrix and stacking-fault precipitates were formed, the 650°C limit of proportionality increasing from a control value of 20,000 lbf/in.^{2} to 50,000 lbf/in.^{2} after irradiation. He bubbles were often attached to the NbC precipitates. (auth) (UK)

8063 AN OXIDE TRANSFORMATION PHENOMENON OBSERVED DURING THE OXIDATION OF NIOBIUM. Sheasby, J. S. (Univ. of Western Ontario, London). Oxidation Metals; 1: 121-5(Autumn 1969).

A mode of the oxidation behavior of niobium, in which the oxide grown on a perfect electropolished surface transforms and inhibits further oxide formation, is reported. (auth)

8064 THE ROLE OF OXIDE PLASTICITY ON THE OXIDATION BEHAVIOR OF METALS: A REVIEW. Douglass, D. L. (Univ. of California, Los Angeles). Oxidation Metals; 1: 127-42(Autumn 1969).

A summary of information on oxidation kinetics and mechanisms of metals is presented. An analysis is included on film macrostresses, film microstresses, film spalling, structural aspects of films, and plasticity of oxides. (J.R.D.)

8065 A REVIEW OF THE BEHAVIOR OF ALUMINIDE-COATED SUPERALLOYS. Lindblad, N. R. (General Electric Co., Schenectady, N. Y.). Oxidation Metals; 1: 143-70(Autumn 1969).

A review of the literature is made regarding the oxidation and hot-corrosion resistance and general behavior of superalloy coatings. Although coating procedures and testing are reviewed, the effect of the coating or coating cycle on mechanical properties and environmental stability is emphasized. Electron microprobe, metallography, and x-ray diffraction phase analyses are discussed in relation to proposed failure mechanisms. (auth)

8066 THE ACTION OF ACIDS, BASES, OXYGEN, AND CHLORINE OF THE NOBLE METALS. pp 1-38 of Analytical Chemistry of the Noble Metals. /Beamish, F. E. New York; Pergamon Press (1966).

The corrosive effects of oxygen, chlorine, and various acids and bases on Ru, Os, Rh, Ir, Pd, Au, and Pt are discussed. The analytical significance of the metallurgical history of each metal is considered. (P.C.H.)

Preparation and Fabrication

Refer also to abstracts 7551, 7585, 8540, and 9076.

8067 (ANL/EBR-6) EFFECTS OF SODIUM AND SODIUM REMOVAL ON THE MICROSTRUCTURE OF TYPE 304L STAINLESS STEEL TUBING. EBR-II Project. Strain, R. V. (Argonne National Lab., Ill. Argonne National Lab., Idaho Falls, Idaho). Aug 1969. Contract W-31-109-eng-38. 18p. Dep. CFSTI.

Type 304L stainless steel tubing is employed as the cladding and encapsulation material for the driver fuel and most experimental capsules in the Experimental Breeder Reactor II (EBR-II) EBR-II is a sodium-cooled fast- breeder reactor and therefore exposes the outside surfaces of the elements and capsules to flowing sodium at temperatures from 700 to 1100°F. The sodium clinging to these surfaces must be removed prior to exposing the subassembly to air for interim or postirradiation examination. The removal is carried out by converting the sodium to sodium oxide and sodium hydroxide with humidified argon and air. The oxidized sodium is removed from the surfaces by flowing water through the subassembly. Metallographic examination has been performed on a large number of samples to determine the effects of the reactor primary sodium and sodium-removal operation on the microstructure of cladding and encapsulation materials. To date, these examinations have revealed no changes that could be attributed to either the reactor sodium or the sodium-removal operation. The microstructural change that has been observed is sensitization (carbide precipitation at the grain boundaries) that is dependent on the temperature of the cladding during reactor operation and on the original carbon content of the material. (auth)

8068 (BNWL-1176) REMOVAL OF SUPERFICIAL BLEMISHES FROM TYPE 316 STAINLESS STEEL FUEL CLADDING. Studer, R. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct 1969. Contract AT(45-1)-1830. 18p. Dep. CFSTI.

During visual examination of an end cap weld on a fuel pin subassembly made for PNL-6, discolorations were found, in about equal profusion, on all lots of Type 316 stainless steel fuel clad tubes produced by one manufacturer, but were absent on process scrap which had not been centerless ground on the outer surface. Tube bores were unaffected. Affected tubes retained normal mechanical properties. Cleaning procedures were revised so that blemishes could be removed without compromising the integrity of the fuel pins. (auth)

8069 (CONF-670533-, pp 162-5) PREPARATION OF THIN FILM SPECIMENS OF IRRADIATED STAINLESS STEEL TUBING FOR TRANSMISSION ELECTRON MICROSCOPY. Owens, C. M.; Aqua, E. N. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.).

The initial designs of pressurized water reactors employed stainless steel as the fuel cladding material. In the evaluation of the cladding performance from one of these reactors (Yankee), it was necessary to develop the techniques for preparing thin film specimens of irradiated tubing for transmission electron microscopy. The principal difficulty that presented itself was the high gamma activity from the residual ^{60}Co products of iron transmutations. The steps required in foil preparation are described and results on Type 348 stainless steel cladding are presented. (auth)

8070 (CONF-670533-, pp 166-76) TECHNIQUE FOR THINNING PLUTONIUM FOR TRANSMISSION ELECTRON MICROSCOPY. Brewer, A. W.; Fraikor, F. J. ([Dow Chemical Co., Golden, Colo. Rocky Flats Div.]).

The technique for preparation, handling, and examining thin foils of Pu-1 wt % Ga for transmission electron microscopy are described. (auth)

8071 (RFP-1353) BETTER VACUUM FOR BETTER PARTS. Culver, Richard S.; Herbst, George (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 24 Sep 1969. Contract AT(29-1)-1106. 10p. Dep. CFSTI.

The results obtained during explosive forming into a die when both inadequate and adequate vacuums are used are described. A mathematical analysis of phenomena observed using inadequate vacuums is presented. Details of vacuum system design and operation as well as practical aspects of vacuum measurement as applied to explosive forming are given. (auth)

8072 (UCRL-71894) CONTROL OF SPIKING IN PARTIAL PENETRATION ELECTRON-BEAM WELDS. Armstrong, R. E. (California Univ., Livermore. Lawrence Radiation Lab.). 8 Aug 1969. 28p. Dep. CFSTI.

The effects of machine parameters—accelerating voltage, heat input, travel speed, beam focus position, and beam oscillation—on the amount of spiking in deep partial-penetration electron-beam welds in uranium was investigated. When the electron-beam is operating in the hole-drilling mode, any parameter change that reduces the power density of the beam in the hole reduces spiking and gives a smoother root, but it also reduces the depth of penetration. When the power density of the beam is increased to regain the depth of penetration, the amount and length of spiking is increased. The conclusion is that spiking is not a function of individual machine parameters but is inherent in a high-depth-to-width-ratio electron-beam weld. (auth)

8073 IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF ARTICLES FROM POWDERED MATERIALS. Marshall, Alec Frank; Taylor, Hugh Gordon (to Birmingham Small Arms Co. Ltd.). British Patent 1,171,315. 19 Nov 1969. Filed 11 May 1966.

A method is described for the production of an encapsulated article using powders of different materials for the core and the encapsulation. The method is stated to be particularly suitable for the production of nuclear fuel elements. By employing a powder technique a mechanical bond and, in certain cases a metallurgical bond, is formed between the various layers, thereby achieving good thermal efficiency. The method consists of introducing into a mould in powder form a layer of encapsulating material, at least one layer of a different core material and a

further layer of encapsulating material. The first layer of encapsulating material occupies the full width and length of the mould, and the layer of core material occupies the full width of the mould but is of reduced length so as to leave spaces between its ends and the mould. These end spaces are filled with encapsulating material to the same thickness as the core layer. The end spaces are filled with encapsulating material to the same thickness as the core layer. The encapsulating and core layers are then precompacted, and the mould sidewalls are adjusted to the desired width of the final article. Further layers of encapsulating material are poured into the mould, so that the layer of core material is surrounded on all sides by the encapsulating material, and the complete powder mass is compacted, released from the mould, and sintered to produce an encapsulated article without any additional binding or welding between adjacent layers. (UK)

8074 PRELIMINARY DATA ON THE FABRICATION OF ALUMINUM CLAD FUEL ELEMENTS WITH URANIUM–ALUMINUM CORE. Haydt, Heliton Motta; Cintra, Sebastiao Hermano (Instituto de Energia Atomica, Sao Paulo, Brazil). Metalurgia (Sao Paulo); 23: 955-9(Dec 1967). (In Portuguese).

The aluminum-clad fuel elements with Al–U alloy core are of great interest for use in research reactors. The hypoeutectic alloys are rolled easily but the hypereutectic ones (more than 13% U) present more difficulties due to the formation of primary crystals of UAl. The experimental studies have consisted of studying the principal variables related to the production of alloys and to the fabrication of aluminum clad fuel plates. Alloys containing 2, 5, 10, 13, 20 and 25% of uranium were studied and prepared by the addition of metallic uranium in liquid aluminum melted in graphite crucible. In all the operations, carried out under protection of ammonium chloride and cryolite, the temperature was of 800°C with exception of the 20 and 25% U alloys, when the temperature of the bath was of 1100°C. The dross was removed carefully before the metallic uranium addition. Casting was done in graphite prismatic molds; small cylindrical ingots were also prepared for other studies. The alloys were then hot rolled at the Stannat-Mann rolling mill from 12.5 mm to 3.2 mm. The experimental studies of the first series of fabrication using the picture frame technique at 600°C and until the final thickness between 1.7 mm and 1.9 mm are discussed. (auth)

8075 PREPARATION OF SINTERABLE URANIUM DIOXIDE. Niederkorn, I.; Circo, Gh. Rev. Chim. (Bucharest); 20: 375-80(Jun 1969). (In Rumanian).

In view of the potential direct use of enriched UO_2 as a nuclear fuel, experiments were carried out to improve the sinterability of the UO_2 powder. Solutions of uranyl nitrate containing 50, 100, 150, and 200 g/l of U were prepared by dissolving UO_3 in HNO_3; a concentrated NH_4OH solution was added up to pH = 8.5 in order to precipitate the ammonium diuranate; the time of addition of the reagent was varied from two to 30 min, while the temperature was varied from 20 to 80°C. At pH = 8.5 the solution was decanted keeping the temperature constant. Similar experiments were carried out to determine the effects of the same factors on the filterability of the diuranate. It was found that maximum sedimentation rate and highest density are obtained with the solution containing 50 g/l of U at a precipitation rate of 30 min at 60 to 80°C. Precipitates with the best filterability were obtained with the 100 g/l solution at low precipitation rates and at 80°C. The highest apparent density of the diuranate after drying at 105°C, namely 1.09 g/cm^3 was obtained by using solutions containing 150 to 200 g/l of U at 20°C under rapid precipitation within 2 min. Heat treatment at 500 to 700°C resulted in losses exceeding the values expected from the formula of $(NH_4)_2U_2O_7$. (TTT)

8076 SOME THERMAL AND MECHANICAL PROPERTIES OF THE INTERMETALLIC COMPOUND $HoZn_2$. Michel, David John. University Park, Pa.; Pennsylvania State Univ. (1968). 83p.

Thesis.

The thermal expansion coefficients of $HoZn_2$ between 25 and 800°C were determined by high temperature x-ray powder diffraction techniques using samples encapsulated in beryllium foil. The coefficients are $\alpha_a = 1.66 \times 10^{-5}$/°C, $\alpha_b = 1/59 \times 10^{-5}$/°C and $\alpha_c = 2.10 \times 10^{-5}$/°C. An attempt to calculate the thermal vibration amplitudes of $HoZn_2$ from the data was unsuccessful. A powder metallurgy technique was developed to prepare cold-pressed and sintered $HoZn_2$ bar specimens for mechanical testing. Specimens with a percentage of theoretical density of 97 percent or greater were compression tested to failure. The stress-strain data obtained yielded a value for Young's modulus of 8.5×10^6 psi. A small amount of plastic deformation is believed to occur in this material due to the appearance upon deformation of twinning near the grain boundaries. The elastic constants of polycrystalline $HoZn_2$ were determined for two cold-pressed and sintered specimens. The transit times of longitudinal and shear ultrasonic waves in the material were determined between 90 and 298°K. Both constants were linear throughout this temperature range. At 298°K, the longitudinal (C_{11}) and shear (C_{44}) constants were found to be 1.035×10^{12} dynes/cm^2 and 0.294×10^{12} dynes/cm^2, respectively. By extrapolating to 0°K, the Debye temperature was found to be 243°K. From the constants at 298°K, Young's modulus = 11.1×10^6 psi. The thermal expansion coefficients of $HoZn_2$ in conjunction with the crystallographic data for other MZn_2 compounds with the KHg_2-type structure was used to predict the thermal expansion coefficients for other $REZn_2$ compounds. The expansion coefficients were found to decrease along both the a and b directions and increase along c as the size of the rare earth atom increases. The expansion is almost isotropic along both a and b. The value of Young's modulus for other $REZn_2$ compounds is expected to be of the same order of magnitude as that found for $HoZn_2$. (Disser. Abstr.)

8077 THE JOINING OF NUCLEAR ENERGY AND THE WELDING ART. Weinberg, Alvin M. (Oak Ridge National Lab., Tenn.). Weld. J. (N.Y.); 48: 867-75(Nov 1969).

The contributions of nuclear science to welding techniques and of welding to nuclear energy are reviewed. The most important of the former is radiography (and the production of radioisotopes for radiography) followed by the development of electron-beam welding. The importance of welding in the development of reactors and nuclear power is reflected in the welding requirements for fuel canning, coolant loops, pressure vessels, chemical piping, and the use of new methods such as gas tungsten-arc and electroslag welding to meet these needs. The encapsulation of radioactive sources by remote welding and the fabrication of elaborate close tolerance fuel elements are mentioned as examples of special welding achievements. Welding requirements for the fabrication and maintenance of future breeder reactors are described as the next major demand of nuclear energy on the welding art. (L.C.L.)

8078 COATED NUCLEAR FUEL OR BREEDER SUBSTANCES AND METHOD OF PRODUCING THE SAME. (to Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH). British Patent 1,173,897. 10 Dec 1969. Priority date 14 Dec 1965, Germany.

A process is described for applying a protective coating consisting essentially of carbon and silicon to gas-cooled high-temperature reactor fuel particles. The method consists of pyrolytically decomposing, in the presence of the particles, at least one organosilane in which each silicon bond not connected to a carbon atom is connected to a hydrogen atom or to another silicon atom. (J.C.W.)

8079 A METHOD FOR PREPARING AN OXIDIC FISSILE MATERIAL CONTAINING A METAL BORIDE. (to Reactor Centrum Nederland). British Patent 1,171,534. 19 Nov 1969. Priority date 5 Oct 1966, Netherlands.

A method is described for fabricating sintered PuO_2, UO_2, or PuO_2–UO_2 fuel material containing UB_4, ThB_4, or a mixture of the borides. The metal-containing mixture is reduced in a carbon monoxide or carbon monoxide-containing mixture until the dioxides in the metal-containing mixture has an oxygen-to-metal atomic ratio in the range of 2.01 to 2.025. The materials are then sintered in an inert atmosphere. (J.C.W.)

8080 FORMATION OF Al–Mo–Ni ALLOYS BY ALUMINUM REDUCTION. Rechkin, V. N.; Samsonova, T. I. Izv. Akad. Nauk SSSR, Metal.; No. 3, 61-3(May-Jun 1969). (In Russian).

By Al reduction of the oxides of molybdenum and nickel, it is possible to obtain predetermined compositions of Al–Mo–Ni alloys. In order to achieve complete metal reduction, CaO was added to form MoO_3, Al_2O_3, and NiO. In the system Al–Mo–Ni, the aluminide Mo_4NiAl_{11} was formed which crystallized into tetragonal crystals with the cell structure of a = 3.73, c = 16.80 Å. (tr-auth)

Properties Evaluations

Refer also to abstracts 7483, 7557, 7597, 8133, 8159, and 8543.

8081 (AERE-R-5944(Vol.2), pp 422-95) ROLE OF CLIMB IN PROCESSES. Mukherjee, Amiya K.; Bird, James E.; Dorn, John E. (California Univ., Berkeley. Lawrence Radiation Lab.).

Substantial strides have been made over the recent past in uncovering the role of many of the important factors that determine the physical mechanisms of high-temperature creep, but many significant details yet require clarification. The apparent activation energies for high-temperature creep of metals and dilute solid-solution alloys are independent of creep stress and strain. In general they are in good agreement with the activation

energy of self diffusion. It has been firmly established that the creep rate is controlled by the rate of atom mobility and is proportional to the diffusivity. The substructural changes in creep are insensitive to the temperature and depend on the time and the stress. During steady-state creep the significant substructural details remain constant. The exponent of the stress dependence of the steady-state creep rate has usually a value of about five, although many exceptions are known. A complete solution of the creep problem in all its generalities cannot yet be given because of a lack of detailed knowledge of effect of such factors ad modulus, grain size, stacking fault energy, subgrain size, and other substructural features. When the temperature dependence of modulus is taken into account the true enthalpy of activation for creep in pure metals is in excellent agreement with the activation enthalpy for self-diffusion. The activation energy for creep does not depend on the jog energy or the stacking-fault energy. Although some experimental observation suggests that the creep rate might increase with an increase in stacking-fault energy, this question is not yet satisfactorily resolved. The subgrain size decreases with increasing stress, however the relations of subgrain size with modulus, stacking-fault energy, or creep rate is not known. Recent evidence suggests that the effect of grain size on creep rate is relatively small. No satisfactory theoretical model exists for primary creep where the structure continually changes with time. Two kinds of models have been suggested for the steady-state creep, e.g., the motion of jogged screw dislocations and the climb of edge dislocations. The screw dislocation models suffer from various handicaps and major modifications are needed to obtain the correct activation energies and stress laws. The climb models appear to account more readily for the observed activation energies and stress laws for creep. However, some of the assumptions in several climb models, e.g., dislocation pile-ups and effectiveness of Lomer–Cottrell barrier that have been used to develop the stress laws are questionable. Furthermore, assumptions regarding constancy of dislocation sources independent of the stress level are not very tenable. The eventual solution of the problem of steady-state creep will depend on a more intimate understanding of the formation, nature and recovery of the substructure. More complete empirical data are needed on the creep behavior of metals having different moduli and different stacking-fault energies to provide an acceptable correlation of their creep rates. Detailed and systematic investigations are also needed on the substructures that are developed with specific emphasis on their significance to the creep mechanism. (auth)

8082 (AERE-R-5944(Vol.3), pp 693-715) TEMPERATURE DEPENDENCE OF YIELD STRESS IN BODY CENTERED CUBIC METALS. Boser, O. (General Telephone and Electronics Labs. Inc., Bayside, N. Y.).

The temperature dependence of the yield stress of various bcc metals such as tungsten, molybdenum, tantalum, niobium, and potassium has been analyzed assuming that point defects with tetragonal symmetry act as obstacles to dislocation motion. The activation energy ΔG_0 for surmounting these obstacles has been evaluated. It is in good agreement with the value found for iron when allowance is made for the variation of the shear modulus. The concentration of the obstacles obtained from the temperature dependence of the yield stress comes very close to that determined by chemical analysis. With the data of ΔG_0 and the obstacle concentration obtained from the stress analysis, the activation volume has been calculated. The agreement with the measured values is very good considering the assumptions made. The results show that the steep increase of the yield stress of bcc metals with decreasing temperature can be explained by impurities in interstitial solution such as carbon, nitrogen, and oxygen. (auth)

8083 (AERE-R-5944(Vol.3), pp 778-88) SOLID SOLUTION HARDENING IN TANTALUM AND NIOBIUM ALLOYS. Mordike, B. L.; Rogausch, K. D. (Liverpool Univ. (England). Dept. of Metallurgy).

Critical resolved shear stress over a range of temperature was investigated using Ta alloys and Nb alloys. Resulting data are presented graphically and an analysis of the data is included. (J.R.D.)

8084 (CALT-221-78) KINETICS OF COARSENING OF THE GAMMA-PRIME PRECIPITATE IN NICKEL–SILICON ALLOYS. Rastogi, P. K. (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Oct 1969. Contract AT(04-3)-221. 53p. Dep. CFSTI.

The coarsening kinetics of Ni_3Si (γ') precipitate in a binary Ni-Si alloy containing 6.5 wt % silicon was studied by magnetic techniques and transmission electronmicroscopy. A calibration curve was established to determine the concentration of silicon in the matrix. The variation of the Si content of the Ni-rich matrix as a function of time followed Lifshitz and Wagner theory for diffusion controlled coarsening phenomena. The estimated values of equilibrium solubility of silicon in the matrix represent the true coherent equilibrium solubilities. The experimental particle-size distributions and average particle size were determined from dark field electron micrographs. The average particle size varied linearly with $t^{-\frac{1}{3}}$. The experimental distributions of particle sizes differed slightly from the theoretical curve at the early stages of aging, but the agreement was satisfactory at the later stages. The values of diffusion coefficient of silicon, interfacial energy, and activation energy were calculated from the results of coarsening kinetics. The experimental value of effective diffusion coefficient was in satisfactory agreement with the value predicted by the application of irreversible thermodynamics to the process of volume constrained growth of coherent precipitate during coarsening. The coherent γ' particles in Ni-Si alloy unlike in Ni-Al and Ni-Ti seemed to lose coherency at high temperature. A mechanism for the formation of semicoherent precipitate is suggested. (auth)

8085 (GEAP-10090) THE 550°F NOTCHED HIGH-STRAIN BEHAVIOR OF THREE LOW-STRENGTH STRUCTURAL STEELS. Krempl, E. E. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Aug 1969. Contract AT(04-3)-189. 29p. Dep. CFSTI.

The 550°F high-strain fatigue behavior of unnotched and notched specimens of a 2¼ Cr–1 Mo steel, a carbon steel, and a Type-304 stainless steel was investigated. The notched behavior was determined for double-edge notched flat plates ($K_t = 3.0$) under zero-to-tension loading, and grooved cylinders ($K_t = 3.3$) under completely reversed loading. Crack initiation and failure were determined in the range of 100 to 100,000 cycles. The cyclic stress-strain diagram, smooth-bar data, and crack-initiation data of the notched specimens were used to determine the fatigue strength reduction factor K_f for crack initiation. The K_f values are given for three different definitions of that factor. Average crack growth rates were determined, and striation density measurements were evaluated. The 550°F results are compared to earlier room temperature results for these same three materials. The largest effects of temperature were exhibited by Type-304 stainless steel. The low-cycle fatigue behavior of 2¼–1 Mo steel was virtually identical for the two temperatures. Carbon steel exhibited, in general, a slight deteriorating effect of temperature, with the exception of the cyclic-strain-hardening capacity, which was much greater at 550°F than at room temperature. (auth)

8086 (GEMP-711) MECHANICAL PROPERTIES OF Fe–Cr–Al–Y ALLOYS. Bartos, J. L.; Perkins, R. J.; Robertshaw, F. C. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). Jul 1969. Contract AT(40-1)-2847. 48p. Dep. CFSTI.

The mechanical properties of several Fe–Cr–Al–Y compositions were characterized and compared, when possible, with annealed Type 304 stainless steel. Properties evaluated include hot hardness, tensile and creep-rupture strength, and bend and impact ductility. All Fe–Cr–Al–Y alloys had lower tensile and creep-rupture properties than annealed 304 SS at all temperatures. The impact ductile-to-brittle transition temperatures ranged from 110 to 195°C. Assessment of these data, coupled with comparison data for oxidation and corrosion resistance, would appear to narrow the range of applicability of these alloys to low stress situations demanding excellent high temperature (950 to 1200°C) oxidation or corrosion resistance. (auth)

8087 (HSSTP-TR-3) GROSS STRAIN MEASURE OF FRACTURE TOUGHNESS OF STEELS. Heavy Section Steel Technology Program Technical Report No. 3, September 1968–November 1969. Randall, P. N. (TRW Systems Group, Redondo Beach, Calif.). 1 Nov 1969. Contract W-7405-eng-26; Sub-contract 3134. 81p. Dep. CFSTI.

For Oak Ridge National Lab., Tenn.

This project was part of an effort to ensure the safety of pressure vessels by developing quantitative means for design against brittle fracture. In the gross-strain approach to such design there are three key variables: maximum expected strain level (usually at some region of high secondary stress); maximum expected flaw severity at that location; and minimum expected fracture toughness of the material at that location at the concurrent temperature, measured in terms of critical gross strain in the presence of sharp cracks of certain sizes. An experimental program was conducted to make such measurements. Key independent variables studied were: flaw size, constraint (specimen thickness and width), temperature, and stress-strain behavior in the yield region. Key measurements made were: gross strain in the net section on a gage length spanning the crack outboard of the crack strain field, gross strain in the gross section above and below the crack, and crack opening displacement, all as a function of load. Critical

values quoted for these quantities were those at maximum load. Test specimens were rectangular tensile bars from plate 01 with thicknesses of 0.49 to 1.40 inches and widths from 1.40 to 4.00 inches. They were pulled in flat wedge grips, mostly at low temperatures. Each specimen contained two semielliptical surface cracks spaced well apart on one face. Cracks were grown in bending fatigue to one of two typical sizes: 0.25 inch deep by 0.80 inch long or 0.38 inch by 1.40 inch. Test results generally revealed transition-temperature behavior. There were significant differences between mid-plate material from locations 3.5 to 7.5 inches from the bottom surface of the plate and material located 2.0 to 3.5 inches from the bottom of the plate. Mid-plate material had a very abrupt transition; gross strain in the net section in the presence of a 0.25 inch deep crack increased from 1% at −10°F to 10%, at +10°F. Failure by tensile instability determined the strain level on the upper shelf. Gross strain in the gross section simultaneously rose from 0.2% (fully elastic) to about 6%. Material from nearer the bottom of the plate showed a more gradual transition in gross strain values. There were also marked differences in yield behavior. Mid-plate material had a yield point elongation of more than 1%, but the other had a smoothly rising stress-strain curve through the yield region. There was clear evidence that onset of yielding in the gross section triggered the transition in crack opening displacement, as well as in gross strain, and that abrupt yield-point behavior caused an abrupt transition. Studies of constraint effects using 0.25 inch deep cracks, resulted in a tentative recommendation that specimen thickness should exceed 2.5 times the crack depth and width should exceed 3 times the crack length to provide enough embedment of the crack tip to that further increases caused no change in crack opening displacement. Critical gross strain in the net section leveled off too, but at values considerably higher than those in the gross section. It was concluded that design values of gross strain crack tolerance should be those measured in the gross section above and below the crack. They would be given as a function of crack size, temperature, ratio of crack area to gross area of the specimen, and some measure of the stress-strain behavior in the yield region. The degree of conservatism involved can probably be estimated from a study of the last two factors. A program to develop these techniques further is outlined. (auth)

8088 (N-69-38320) TENSILE PROPERTIES OF UNALLOYED TANTALUM AT TEMPERATURES UP TO 1350°F (1000°K). Spagnuolo, Adolph C.; Stone, Phillip L. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Sep 1969. 9p. (NASA-TM-X-52670). CFSTI.

Unalloyed tantalum tensile specimens of various shapes and different heats were tested at various elevated temperatures (450 to 1350°F (505 to 1005°K)), at a vacuum level of 4.1×10^{-6} torr (5.5×10^{-4} N/M^2) or less. Much scattering was observed in the ultimate stress, from 15,500 to 28,000 psi (10.5×10^7 to 19.3×10^7 N/m^2), among the different shapes tested at the same temperature, 1350°F (1005°K). Correlation, however, was good among specimens machined from the same heat, 20,200 to 23,400 psi for the tube specimens. (STAR)

8089 (NYO-2394-39) OBSERVATIONS ON THE FRACTURE OF CEMENTITE PARTICLES IN A SPHEROIDIZED 1.05 PERCENT C STEEL DEFORMED AT ROOM TEMPERATURE. Technical Report No. 39. Gurland, J. (Brown Univ., Providence, R. I. Div. of Engineering). Sep 1969. Contract AT(30-1)-2394. 29p. Dep. CFSTI.

The initiation of fracture at carbide particles during plastic deformation was observed in tension, compression, torsion, fatigue and impulsive loading. In tension, compression and torsion, cracks are initiated in the particles, in a direction normal to the tensile stress in the particles. The size and orientation of the particles broken in tension were also studied. Stable fatigue cracks tend to by-pass the particles, but favor the particle-matrix boundaries. Brittle fractures caused by impulsive loading propagate through matrix and carbide particles, sometimes, however, avoiding the smaller particles. (auth)

8090 (ORNL-tr-2228) VAPOR PRESSURE MEASUREMENTS IN THE LEAD–THORIUM SYSTEM. Gans, Wigbert; Knacke, Ottmar; Mueller, Franz; Witte, Hartmut. Translated by C. E. Schilling (Oak Ridge National Lab., Tenn.), from Z. Metallk.; 57: No. 1, 46-9(1966). 8p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 20: 19244.

8091 (ORNL-tr-2246) ROLE OF NIOBIUM IN THE IMPROVEMENT OF THE MECHANICAL PROPERTIES OF WELDABLE CONSTRUCTION STEELS. Mandry, Pierre. Translated for Oak Ridge National Lab., Tenn., from Metaux (Corros.-Ind.); 43: 24-48(1968). 49p. Dep. CFSTI.

The physical properties of niobium are reviewed with special attention to solubility properties. The hypotheses of the mechanism by which niobium improves hardening in steels are summarized. The effects of niobium additions on austenite, ferrite, and martensite are considered. In the immediate vicinity of the welding bead, fusion of the metal caused coarsening of the grain and additional embrittlement due to the niobium which was observed after austenitization at 1300°C and accelerated cooling. Since niobium dissolved in the austenite enhanced its hardenability, significant bead hardnesses can be expected because of the appearance of mixed decomposition products during cooling. (J.C.W.)

8092 (SRO-552-1) QUANTITATIVE DETERMINATION OF THE STRUCTURE–PROPERTY RELATIONSHIPS IN NUCLEAR FUEL ELEMENT MATERIALS. Quarterly Progress Report, June 15–September 15, 1969. Rhines, F. N.; DeHoff, R. T.; Hench, L. L. (Florida Univ., Gainesville. Dept. of Metallurgical and Materials Engineering). Oct 1969. Contract AT(38-1)-552. 14p. Dep. CFSTI.

Quantitative relationships between microstructure and physical and mechanical properties of porous nickel and UO_2 bodies are to be investigated. The nickel powder has been procured and characterized; sintered samples showed the development of porosity internally contained within the nickel powder particles. Quantitative microscopic analyses were made, and the results compared with earlier observations for other equiaxed powders which do not exhibit this internally confined porosity. Treatments for eliminating this porosity are under study. The development of metallographic procedures for UO_2 has also been undertaken, and is reported. (auth)

8093 GROWTH KINETICS OF ZIRCONIUM ANODIC OXIDE AND ITS ALLOYS. Dassu, G. (Politecnico, Milan); Alessandrini, G.; Peruzzi, R. Energ. Nucl. (Milan); 16: 647-53(Oct 1969).

Experimental growth kinetics of zirconium anodic oxide and its alloys, in the 1,000 to 10,000 Å range of thickness were investigated. Through steady state measurements, the validity of the transport fundamental law, known as high field approximation, was verified: $i_+ = A_+ \exp B_+ E$. Anodizations were performed in 1% KOH bath, either at constant voltage or at constant current density, on reactor-grade zirconium and Zircaloy-4. Current density against time characteristic curves of anodic oxidization process on reactor-grade zirconium were compared with those obtained on Zircaloy-4, both untreated and thermally treated (840°C for 30', water quenched). (auth)

8094 SELF AND SOLUTE DIFFUSION IN ZIRCONIUM. I. THE DIFFUSION OF ^{60}Co IN β Zr. Kidson, G. V.; Young, G. J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phil. Mag.; 20: 1047-56(Nov 1969).

The diffusion coefficient of ^{60}Co in the bcc β phase of 99.99% pure polycrystalline zirconium was measured at 920 to 1700°C. The Arrhenius plot of log D versus 1/T shows some evidence of positive curvature above 1600°C but below that it is strictly linear and can be represented by: $D = [3.26 \pm 2.77] \times 10^{-3} \exp(-21{,}820 \pm 900/RT)$ cm^2/sec. Anomalies in the concentration profiles were noted in experiments at temperatures below 1200°C. A reason for their origin is suggested. (auth) (UK)

8095 THE TEMPERATURE DEPENDENCE OF THE LONGITUDINAL THERMOGALVANIC EFFECT IN IRON–NICKEL ALLOYS CONTAINING MOLYBDENUM. Ali-Zade, Z. I.; Panakhov, T. M. Uch. Zap. Azerb. Gos. Univ., Ser. Fiz.-Mat. Nauk; No. 4, 87-90(1968). (In Russian).

The temperature dependence of the longitudinal thermo-galvanic effect was studied in quenched or annealed alloys close to Ni_3Fe in composition and containing 3, 6, and 9 at. % Mo. The value of the galvano-magnetic effect increased sharply in weak magnetic fields. During the transition from displacement to the rotation process, the growth of the galvano-magnetic effect was considerably inhibited, tending to saturation. In fields exceeding technical saturation there is a decrease in the value of the galvano-magnetic effect connected with the paraprocess. With increase in temperature the saturation is reached in weaker fields. Although the course of the change in the galvano-magnetic effect is independent of the Mo content, with increase in the concentration of Mo the value of the galvano-magnetic effect and the values of the Curie point fall sharply. (Referationyi Zh.)

8096 PRODUCTION OF HIGH-RESISTANCE ANODIC FILMS ON CADMIUM. Ikonopisov, S.; Nikolov, Ts. God. Khim. Tekhnol. Inst.; 13: No. 1, 193-204(1966). (In Bulgarian).

The anodizing of Cd in aqueous solutions of H_3BO_3 neutralized to various pH values with NaOH is described. Particularly high-resistance films are obtained at pH 8 to 10. Care is required when choosing the electrical parameters of the process, as excessive voltages tend to produce sudden dielectric breakdown.

The kinetics of the galvanostatic anodizing of Cd under the conditions studied are discussed, assuming a two-layered structure of the surface film, and the relative importance of electronic and ionic conduction is considered. (Metals. Abstr.)

8097 CORROSION IN FLUORINATING ENVIRONMENT. PART 1. Vincent, L.; Gillardeau, J.; Hasson, R.; Maraval, S. (CEN, Saclay, France). Energ. Nucl. (Paris); 11: 400-10(Oct 1969). (In French).

In view of the development of fluorine chemistry in both research and industry, special attention must be devoted to problems concerning the resistance of materials. Some fundamental aspects of fluorination reactions are briefly outlined, after which the criteria governing the use of materials in fluorinating gases are discussed. A summary is given of the possible applications of nickel, monel, stainless steel, copper, brass, steel, aluminum, magnesium, and teflon in gaseous and liquid fluorides. (J.C.W.)

8098 NUCLEAR USES OF VANADIUM METAL AND ALLOYS. Trouve, J.; Kauffmann, Y.; Accary, A. Energ. Nucl. (Paris); 11: 423-6(Oct 1969). (In French).

The properties required for an alloy to be used as a canning material for the fuel element of a sodium cooled and ceramic fueled fast reactor are reviewed. It was found that the classical materials fall short of the irradiation stability necessary for the high burn-up usually contemplated. The vanadium based alloys are considered as an alternative solution. It was concluded that at least if the sodium is purified by hot trapping, the alloys that can be fabricated under the suitable shape for canning purpose are acceptable and able to stand fluences of the order of 5×10^{22} neutrons/cm^{-2}. (auth)

8099 DEVELOPMENT OF COLUMBIUM BERYLLIDES FOR HIGH-TEMPERATURE STRUCTURAL APPLICATIONS. Kirby, Robert Francis. Tucson, Ariz.; Univ. of Arizona (1969). 120p.

Thesis.

A fabrication process for Be–Nb alloys was developed which differed from previously reported processes and which offered several distinct advantages over these earlier processes. The beryllides in the high-beryllium region of the beryllium-niobium system were of particular interest because of their low densities and reported high-temperature strengths. These beryllides represent beryllium compositions corresponding to the compound Nb_2Be_{17} and greater. Since there was some question as to the exact phase relationships in this region, studies were performed to define these relationships and thus allow some bases for stoichiometric design of niobium beryllides. Mechanical-property test results indicated that a composition intermediate between the compounds Nb_2Be_{17} and $NbBe_{12}$ apparently offered the greatest potential for good strength properties. Materials of this intermediate composition were two-phase, consisting of a mixture of $NbBe_{12}$ and Nb_2Be_{17}. Further development work was done on this composition. Additional testing showed that small additions of aluminum to the mixture increased its oxidation resistance and, although decreasing its high-temperature strength, resulted in an increase in ductility. For these reasons, the final composition developed and established as having the greatest potential was $NbBe_{10}$ + 0.5 percent Al. As a final step, tensile and stress-rupture properties were developed for the selected composition to allow its evaluation as a structural material with respect to other high-temperature materials. (Disser. Abstr.)

8100 EXPERIMENTAL WEAR INVESTIGATION ON METAL PAIRS IN VACUUM AT PRESSURES DOWN TO 10^{-9} TORR. Weigand, H.; Heinke, G. Metalloberflaeche; 23: No. 3, 78-86 (Mar 1969). (In German).

Wear tests were carried out on bronze/Ni, bronze/Cr, CuCr, and on hard-Cr-plated, and hardened tool steel/chemical-Ni-plated rolls. The amount of abraded material became less as the pressure was reduced. This was due to the absence of O. At pressure below 1 torr oxide formation was impossible. At 10^{-3} torr wear was mostly in the form of metal transfer. (Metals Abstr.)

8101 COMPARISON OF INERTIA BONDED AND ELECTRON BEAM WELDED JOINTS IN A NICKEL-BASE SUPERALLOY. Doyle, J. R. (United Aircraft Corp., East Hartford, Conn.); Vozzella, P. A.; Wallace, F. J.; Dunthorne, H. B. Weld. Res. (Publ. in Weld. J. (N.Y.)); 48: 514-s-20(Nov 1969).

Comparative metallurgical and mechanical data were obtained on both inertia bonded and electron beam welded joints of Waspaloy, a precipitation hardenable nickel-base superalloy, to evaluate suitability for aircraft gas turbine engine applications. Wrought bar was utilized in the solution heat-treated condition and of a representative size for engine applications. Joining parameters were optimized for specific joint designs. The applicability and limitations of nondestructive testing techniques as applied to both joining processes were determined after removal of surface flash and bead, and full solution, precipitation, and age heat treatment. Radiographic, fluorescent penetrant, and ultrasonic pulse-echo (longitudinal and angle scan) techniques were used. Significant reductions in ultrasonic signal resolution were noted due to the high internal scattering effect of the precipitation hardened superalloy. A thorough investigation of the mechanical properties of both inertia bonded and electron beam welded joints was performed. Testing included room and 800°F tensile, 1200°F creep, and 800°F low cycle and high cycle fatigue. The possibility of metallurgical instabilities in the joint area was investigated by tensile testing after 1000 hr of elevated temperature under stress. Simulation of a gas turbine engine stress condition was accomplished in an 800°F torsional fatigue rig. Metallographic joint examination, in conjunction with fractographic observation of post-test specimens, and a thorough analysis of joint mechanical properties data were utilized to support conclusions regarding specific advantages and limitations of both joining processes. (auth)

8102 SPECTRAL EMITTANCE OF TANTALUM CARBIDE. Johansen, H. A.; Comenetz, G. (Westinghouse Research Labs., Pittsburgh). Pure Appl. Chem., Suppl.; 525-33(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

The emittance of tantalum carbide is seen to be a property of complex nature. Factors such as surface alteration, gas contamination, surface films, stoichiometry, and degree of smoothness, are all to be considered in assessing a true temperature reading. The influence of these factors must be determined on an individual basis for each particular experimental circumstance. For unpolished tantalum carbide in inert atmosphere, free from surface oxide or other films, and with a high stoichiometry, the best value of the emittance for temperatures above 2500°C appears to be between 0.5 and 0.6. For stoichiometry less than x = 0.9, the best value appears to be about 0.45 above 2500°C. (auth)

8103 EMISSIVITY OF SOME REFRACTORY METALS AT HIGH TEMPERATURES. Petrov, V. A.; Chekhovskoi, V. Ya. (Inst. for High Temperature, Moscow). Pure Appl. Chem., Suppl.; 673-83(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

An apparatus is described for determination of hemispheric emissivity and spectral emissivity of specimens for an effective wavelength $\lambda = 0.66\ \mu$. A thin-walled tubular sample was heated by electric current in water-cooled vacuum chamber. The total emissivity was determined by measurement of current flow in the specimen along with voltage on the isothermal test section, the true temperature of the radiant surface, and the geometrical dimensions of the section. (J.R.D.)

8104 THERMAL CONDUCTIVITY AND TOTAL EMITTANCE OF TANTALUM, TUNGSTEN, RHENIUM, Ta–10W, T_{111}, T_{222}, AND W–25Re IN THE TEMPERATURE RANGE 1500 TO 2800°K. Jun, C. K.; Hoch, M. (Univ. of Cincinnati). Pure Appl. Chem., Suppl.; 535-45(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

Descriptions of the experimental methods, equipment, and materials used in the investigations are given. The results are discussed and presented tabularly. (J.R.D.)

8105 THE EFFECT OF ALLOYING ELEMENTS ON THE THERMODYNAMIC PROPERTIES OF NICKEL–ALUMINUM ALLOYS. Malkin, V. I.; Pokidyshev, V. V. Sb. Tr. Inst. Metalloved. Fiz. Metal. Tsent. Nauch.-Issled. Inst. Chern. Met.; No. 59, 94-9(1968). (In Russian).

Emf methods were used to study the thermodynamic properties of the γ solid solutions and of the γ' phase (Ni_3Al) in alloys of the Ni–Al, Ni–Al–Cr, Ni–Al–W, Ni–Al–Co, and Ni–Al–Fe systems between 1045 and 1180°K. Negative deviations from Raoult's law were found in all systems; these decreased with increasing temperature signifying strong interatomic reaction, the greatest deviation taking place in the Ni–Al system. The Al activity was increased by addition of a third alloying component in the following order: Co, Fe, Cr, W. This order applied both for alloys of the γ solid solution and also for the γ' phase. The effect of the concentration dependence of the activity of the components of the Ni–Al–Cr system on the boundaries of the γ and γ' phases with the $\gamma + \gamma'$ two-phase region were also examined. In the γ' phase the replacement of part of the Al by Cr raised the activity coefficient of the Ni. (Referativnyi Zh.)

8106 THERMODYNAMIC PROPERTIES OF CARBIDES FROM ELECTROMOTIVE FORCE MEASUREMENTS. Alekseev, V. I.; Malkin, V. I.; Pokidyshev, V. V. Sb. Tr. Inst. Metalloved. Fiz. Metal. Tsent. Nauch.-Issled. Inst. Chern. Met.; No. 59, 111-15(1968). (In Russian).

Results from emf measurements using liquid chloride and iodide melts (1045 to 1180°K) showed appreciable positive deviations from ideality for Fe both in carbides $(Fe_xMo_{1-x})_2C$ and in carbides of the Fe–Mo–C system in equilibrium with these. From emf measurements the activity of Cr in Cr_3C_2 was determined and the value used to calculate the free energy of formation of the carbide. This was in good agreement with literature data. (Referativnyi Zh.)

8107 THERMODYNAMIC ACTIVITY OF CARBON IN CARBIDES OF MOLYBDENUM ALLOYED WITH IRON, NICKEL, AND TITANIUM. Alekseev, V. I.; Surovoi, Yu. N. Sb. Tr. Inst. Metalloved. Fiz. Metal. Tsent. Nauch.-Issled. Inst. Chern. Met.; No. 59, 110-11(1968). (In Russian).

The CH_4–H gas equilibrium method in the 600 to 900°C range was used to determine the thermodynamic activity of C in pure Mo_2C and when alloyed with small quantities of Fe (↑3), Ni (↑2), and Ti (↑3.9%). The experimental data were used to calculate the partial free energies, enthalpies, and entropies of solution of graphite in alloyed Mo_2C. The partial thermodynamic properties of C in the carbide do not have a monotonous dependence on the alloying element concentration. The latter has a particularly strong effect on the partial heats and entropies. The results are discussed in terms of electronic structure of the interstitial phases and of pair interactions. (Referativnyi Zh.)

8108 TALKING OF THE STRUCTURAL MATERIALS FOR POWER REACTORS IN JAPAN, TODAY. PART 1. Mishima, Yoshitsugu (Tokyo Univ.). Shin Kinzoku Kogyo; 14: 205-15 (Aug 1969). (In Japanese).

The structural materials for power reactors in Japan are discussed under the topics: power reactor development, improvement in light water reactors, and beryllium as cladding materials. Swelling due to helium bubble formation and the corrective measures for this problem are discussed with special reference to the latest Japanese work on beryllium and austenitic stainless steel in the laboratory. (NSA of Japan)

8109 TALKING OF THE STRUCTURAL MATERIALS FOR POWER REACTORS IN JAPAN, TODAY. PART 2. Mishima, Yoshitsugu (Tokyo Univ.). Shin Kinzoku Kogyo; 14: 231-40 (Sep 1969). (In Japanese).

Various methods for the evaluation of circumferential ductility of cladding tube are reviewed. A method for expanding the tube throughout a considerable length by using a lead insert was developed. Flattening test, ring tension test, and flare test are also discussed. It was found that Knoop hardness indentations can be used for rough determination of the texture of cladding tubes in the case of hexagonal metals of beryllium and zirconium. Hydride problems in Zircaloy are described. Standardization of the F_n value and Japanese Industrial Specifications for Zircaloy and its related problems are also discussed. (NSA of Japan)

8110 TALKING OF THE STRUCTURAL MATERIALS FOR POWER REACTORS IN JAPAN, TODAY. PART 3. Mishima, Yoshitsugu (Tokyo Univ.). Shin Kinzoku Kogyo; 14: 271-8 (Oct 1969). (In Japanese).

The cooperative studies which have been carried out in Japan by the Specialists Committee for Study of Nuclear Fuel Safety during the past 10 years are briefly reviewed, based on the compilation of the data concerning the failure of cladding both in the normal operating conditions and under loss-of-coolant accident conditions. Behavior of cladding, zirconium-water reaction, and the estimation of the amount of released fission products from the fuel are discussed. Circumferential deformation of cladding tube due to stresses caused by fission product gas pressure or pellet swelling is discussed. Methods for studying these problems are proposed. (NSA of Japan)

8111 TALKING OF THE STRUCTURAL MATERIALS FOR POWER REACTORS IN JAPAN, TO-DAY. PART 4. Mishima, Yoshitsugu (Tokyo Univ.). Shin Kinzoku Kogyo; 14: 299-308 (Nov 1969). (In Japanese).

Various methods of introducing the intended amount of hydrogen into zirconium have been surveyed and some experiences in Japan are described. The stress orientation of hydrides in Zircaloy is discussed. The effects of cyclic load and temperature changes, corresponding to the actual conditions of reactor operation on the orientation of hydride stringer are discussed based on recent experimental results. Pressure tube and calandria tube materials for the heavy water-moderated, boiling light water-cooled Japanese ATR are considered. (NSA of Japan)

8112 STRUCTURE AND PROPERTIES OF SPUTTERED Ta–Al_2O_3 CERMET THIN FILMS. Henrickson, J. F. (Western Electric Co., Princeton, N. J.); Krauss, G.; Tauber, R. N.; Sharp, D. J. J. Appl. Phys.; 40: 5006-14(Dec 1969).

Ta–Al_2O_3 cermet thin films were produced by diode sputtering. Cathodes were fabricated by powder techniques, plasma spraying, and as mechanical composites. Film compositions of 1–20 wt % Al_2O_3 produced resistivities of 250 to 25,000 $\mu\Omega \cdot cm$ and TCR's of +100 to −450 ppM/°C, respectively. The films showed good thermal stability and could be anodized. Electron microscopy and x-ray analyses suggest a film structure consisting of long columnar grains of bcc Ta, approximately 100 Å in diameter, surrounded by Al_2O_3. A quantitative analysis is made of tunneling currents in an idealized film. Resistivity-composition and resistivity-temperature data are explained in terms of this analysis. The height of the Al_2O_3 barrier between grains is estimated to be 0.23 eV for an effective electron mass of 1/9. Barrier thicknesses are estimated at 15–30 Å. (auth)

8113 DIFFUSION OF CARBON IN NIOBIUM ALLOYS WITH TITANIUM, ZIRCONIUM, TUNGSTEN, OR MOLYBDENUM. Lyubimov, V. D.; Gel'd, P. R.; Bogomolov, G. D.; Tskhai, V. A.; Shveikin, G. P. Izv. Akad. Nauk SSSR, Metal.; No. 3, 201-6(May-Jun 1969). (In Russian).

The parameters of carbon diffusion in niobium alloys with titanium, zirconium, tungsten, or molybdenum were measured by recording the layers and integral activities of the precipitates. Addition of the initial amounts of alloying elements resulted in a decrease of parameters of diffusion. Further additions resulted in more or less monotonous changes, depending mainly on the electron structure of the alloying element. Variations of diffusion constants depended on the structure of near order, deformations of crystalline structure, and peculiarities of the electron structure of the alloys. (tr-auth)

8114 DIFFUSION OF BERYLLIUM IN ZIRCONIUM AND TITANIUM. Pavlinov, L. V.; Grigor'ev, G. V.; Gromyko, G. O. Izv. Akad. Nauk SSSR, Metal.; No. 3, 207-9(May-Jun 1969). (In Russian).

The diffusion of beryllium in zirconium and titanium was characterized by the high diffusion constants equal to 5 to 2×10^{-5} cm^2/sec at the melting point of the base. The energy of activation and the level of diffusion mobility of beryllium, as with other metallic impurities in zirconium and titanium, were a function of the melting point of hypothetical zirconium-base–uranium alloy with 7 to 8 at. % impurities. (tr-auth)

8115 DETERMINATION OF VAPOR PRESSURE OF LIQUID METALLIC GALLIUM. Matern, G.; Sapozhnikov, Yu. A.; Khardzhosukanto, S.; Priselkov, Yu. A. Izv. Akad. Nauk SSSR, Metal.; No. 3, 210-15(May-Jun 1969). (In Russian).

The vapor pressure of nonradioactive (99.999%) and radioactive (more than 99.98%) gallium was measured at 1062 to 1217°K on improved apparatus of continuous action by the integral variant of effusive method. It was found that the vapor pressure of nonradioactive gallium depends considerably on the ratio of evaporation area to effusive opening area. It was established that the vapor pressure of radioactive gallium achieves equilibrium with the large area of effusive opening. (tr-auth)

8116 DEFORMATION OF LANTHANUM. Gladkikh, A. N.; Skudnov, V. A.; Sokolov, L. D. Izv. Akad. Nauk SSSR, Metal.; No. 3, 94-7(May-Jun 1969). (In Russian).

Ductility studies were made on annealed lanthanum (98.6 wt %) at −196 to 681°C at the rate of deformation $E = 2 \times 10^{-2}$ and 2×10^{-1} sec^{-1}. In order to determine the strength, the function was determined by the rate of deformation, $\sigma_\delta = E^n$. The temperature of deformation and the characteristics of ductility were correlated. (tr-auth)

8117 SOLUBILITY OF TANTALUM, MOLYBDENUM, AND TUNGSTEN CHLORIDES IN TITANIUM TETRACHLORIDE. Reznichenka, V. A.; Moinov, S. G.; Egorov, S. I.; Laktyushin, V. S. Izv. Akad. Nauk SSSR, Metal.; No. 3, 56-60(May-Jun 1969). (In Russian).

The results showed that tungsten hexachloride had the highest and molybdenum pentachloride the lowest solubility in titanium tetrachloride. The heats of dissolution were evaluated and the equations for the free energies of the process are given. (tr-auth)

8118 SUPERCONDUCTIVITY IN THE LAMELLAR STRUCTURES OF TYPE $NbSe_2$. Antonova, E. A.; Kiseleva, K. V.; Medvedev, S. A. (Lebedev Inst. of Physics, Moscow). Fiz. Metal. Metalloved.; 27: 441-5(Mar 1969). (In Russian).

The superconductivity of a two-layer modification of $NbSe_2$ is considered in relation to the degree of divergence from stoichiometry in the compositions 31.7 to 34.3 at. % Nb. The structure of the compound was studied by x-ray analysis. It was found that there is a strict correlation between the state of sublattices of Nb and the critical transition temperature. Conclusions were made concerning the plane characteristics of the superconductivity in $NbSe_2$. (tr-auth)

8119 DETERMINATION OF THERMODYNAMIC CRITICAL MAGNETIC FIELD OF TWO-ZONE SUPERCONDUCTOR. Moskalenko, V. A.; Golub, A. A.; Dryuma, V. S. (Inst. of Mathematics and Computer Center, Kishinev). Fiz. Metal. Metalloved.; 27: 415-18(Mar 1969). (In Russian).

Mathematical equations were obtained for low temperature thermodynamic critical magnetic field $H_c(T)$, where T is the temperature), in a two-zone superconductor with nonmagnetic impurities. The relation of $H_c(T)$ with the concentration of impurities in indium alloys was investigated. (tr-auth)

Structure and Phase Studies

8120 (AECL-3428) DEFECTS IN QUENCHED ZIRCONIUM. Swanson, M. L.; Piercy, G. R.; Kidson, G. V.; Quenneville, A. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Sep 1969. 16p. Dep. CFSTI (U. S. Sales Only). AECL $1.00.

Zirconium wires were quenched from 600 to 800°C in gaseous or liquid He, using cryogenic pumping to avoid absorption of impurities. The apparent concentration of defects (as determined by residual electrical resistivity increments) which were retained in 0.015 cm diameter wires by quenching from 700°C was 10^{-4}, which was much larger than the expected thermal equilibrium defect concentration. The data indicate that this effect could be caused partly by quenching strains and partly by redissolution of impurities. The quenched-in resistivity increments of 0.035 cm diameter wires were much larger than those of thinner wires. Addition of as much as 5 at.% O did not appreciably affect the results. The quenched-in resistivity increments annealed out near 400°C. (auth)

8121 (AERE-R-5944(Vol.2), pp 324-66) EXPERIMENTAL OBSERVATIONS OF CLIMB PROCESSES. Smallman, R. E. (Birmingham Univ. (England). Dept. of Physical Metallurgy and Science of Materials).

Recent experimental evidence on dislocation climb is presented, with particular reference to the results of direct observations using thin-foil transmission electron microscopy. The annealing behavior of prismatic and faulted loops in aluminum afford the most direct observation of climb. The kinetics of climb during the shrinkage of loops support a vacancy-diffusion mechanism and allow the stacking fault energy of intrinsic and extrinsic faults to be determined. Similar behavior is observed in aluminum alloys with the exception of Al–Mg alloys for which the climb process leads to the growth of primatic loops. In this case, the vacancy supersaturation is produced by surface oxidation of the magnesium, and the detailed climb behavior depends on the particular conditions of loop size, alloying addition, and oxygen pressure. Vacancy supersaturation may also be produced in gold and the growth of tetrahedra directly observed. In both fcc and cp hex metals climb processes following heterogeneous nucleation of vacancy defects produce many complex clustered vacancy defects including double-faulted, multi-component double faulted and triple faulted loops. The structure of these defects may be determined from an analysis of the climb behavior during annealing. In presence of a vacancy supersaturation these defects grow and in hexagonal metals, the growth kinetics can be analyzed to give values of the stacking fault energy. The importance of establishing which climb process (shrinkage or growth) in operating is brought out by these experiments, since double-loop growth behavior may be misinterpreted for single loop shrinkage behavior, in quantitative climb measurements; some examples from zinc and magnesium are presented. Experimental evidence for climb processes in bcc metals is much more limited, particularly in quenched metals. Ordered bcc (CsCl-structure) materials do however show climb effects leading to dislocation loop and helical formation. These results are interpreted in terms of the relative magnitude of the vacancy formation and motion energies and are reported. (auth)

8122 (AERE-R-5944(Vol.2), pp 531-46) CREEP OF BERYLLIUM SINGLE CRYSTALS COMPRESSED ALONG THE C AXIS. Le Hazif, R.; Adda, Y.; Dupouy, J. M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

Deformation of Be by dislocation climb was investigated. It was found that single crystals of Be compressed along the C axis deform by transport of matter between sources of vacancies such as $\bar{a}$ dislocations and sinks. (J.R.D.)

8123 (CALT-221-80) RADIAL DISTRIBUTION FUNCTION OF AMORPHOUS Ni–Pt–P ALLOYS. Sinha, Ashok K.; Duwez, Pol (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Nov 1969. Contract AT(04-3)-221. 22p. Dep. CFSTI.

Accurate x-ray diffraction measurements were made upon amorphous alloys having the composition $(Ni_xPt_{100-x})_{75}P_{25}$ with $20 \leq x \leq 60$, which were obtained by rapid quenching from the liquid state. The shapes of the interference function a(K), and of the atomic radial distribution function (RDF) curves are strikingly similar to those observed for metallic liquids. Contrary to what was observed in previously studied amorphous metallic alloys, there is no shoulder on the high angle side of the second peak of a(K) and the RDF does not have a double peak beyond the first maximum. The ratio of second to first near-neighbor atomic distances is 1.87 ± 0.01, a value which is larger than that (~1.7) observed for previously known amorphous films. The first coordination number is close to 12. On the basis of these and further experimental studies on the first band of various amorphous metallic alloys, it is concluded that the present alloys possess a higher degree of disorder than that found in any of the existing amorphous metallic materials. The degree of disorder is comparable to that present in fused silica. (auth)

8124 (CONF-670533–, pp 1-15) TECHNIQUE FOR POLISHING AND ETCHING BERYLLIUM. Wheeler, G. A.; Price, C. W. (Battelle Memorial Inst., Columbus, Ohio).

A metallographic technique is described for beryllium that produces both a satisfactory polish and an excellent bright-field etch. An electrolyte of hydrochloric, nitric, and perchloric acids in ethylene glycol is used. Examples of polishes and etches that can be achieved with this technique are given. (auth)

8125 (CONF-670533–, pp 98-105) SIMPLIFIED METALLOGRAPHIC TECHNIQUES FOR URANIUM ALLOYS AND OTHER METALS. Jackson, Ross J.; Johns, W. L.; Calabra, Arthur E. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.).

A simplified metallographic preparation method was developed and proved suitable for many uranium alloys, as well as for beryllium and stainless steel. Samples used in the study were taken from a cut-off wheel or 600-grit paper and placed in an electrolytic cell. Through the procedures developed, mounting and polishing steps were eliminated and economies in operations achieved. (auth)

8126 (CONF-670533–, pp 177-91) TRANSMISSION ELECTRON MICROSCOPY INVESTIGATION OF THE STRUCTURE OF WELDED TYPE 304 ELC STAINLESS STEEL. Downs, G. L. (Mound Lab., Miamisburg, Ohio).

Results of electron transmission microscopy of 304 ELC stainless steel specimens incorporating fusion welds and 308 stainless steel filler welds are reported. Details of the microstructure as affected by stress, impurities, and segregation are discussed. (J.R.D.)

8127 (CONF-670533–, pp 192-205) INVESTIGATION OF THICK FILMS OF VAPOR-DEPOSITED ALUMINUM AND GOLD BY TRANSMISSION ELECTRON MICROSCOPY. Downs, G. L.; Braun, J. D. (Mound Lab., Miamisburg, Ohio).

The structures of metals vapor deposited on methacrylate and glass surfaces were investigated to correlate grain size and defect structure with physical properties. Micrographs of thinned specimens of aluminum and gold are included and analyzed. (J.R.D.)

8128 (N-69-39182) DISLOCATION STRUCTURES IN SINGLE CRYSTAL TUNGSTEN AND TUNGSTEN ALLOYS. Stevens, Joseph R. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Oct 1969. 21p. (NASA-TN-D-5493; E-5098). CFSTI.

Deformation of tungsten single crystals as a function of strain, temperature, and alloying was studied by transmission electron microscopy. Unalloyed tungsten, W-1 and 3 percent Re, and W-1 and 3 percent Ta single crystals oriented for (101) [111] slip were deformed in compression at 150, 300, and 590°K. Transmission microscopy revealed that the substructure in unalloyed tungsten is similar to substructures in other refractory metals when compared on the basis of homologous temperature. The primary effect of rhenium additions is to produce edge dipoles in the wake of screw dislocations. Tantalum has a lesser effect on dislocation substructure. (auth) (STAR)

8129 (SC-CR-69-3070) DEVELOPMENT OF MELTING AND CASTING PROCEDURES FOR NITINOL NICKEL-BASE ALLOYS. Drennen, D. C.; Jackson, C. M.; Wagner, H. J. (Battelle Memorial Inst., Columbus, Ohio). 15 Dec 1968. Contract No. 16-7540. 33p. Dep. CFSTI.

For Sandia Labs., Albuquerque, N. Mex.

Melting and casting experiments were conducted on 55-Nitinol, a 55% Ni–45% Ti alloy, in ATJ graphite crucibles. The results of the experiments utilizing the ATJ graphite crucible showed that Nitinol alloys can be vacuum melted and contained very well in this material. No problems were encountered during vacuum melting of the alloys that could be attributed to the ATJ graphite crucible. A melting and casting procedure for Nitinol alloys was developed, and several large, high-quality ingots and smaller rod castings were prepared. With very few exceptions, the analyzed

titanium contents were within ±0.3 percent of the intended amounts. Also, the carbon levels were relatively low (varying from 0.052 to 0.074 weight percent); little if any pickup from the crucible was indicated. The results of the transition (shape recovery) temperature studies indicated that the experimental Nitinol alloys have transition temperatures ranging from approximately 55 to 278°F, depending on composition. Furthermore, the data confirm that the transition temperature is a very sensitive function of the titanium content of the alloy. A curve illustrating this relationship was developed. Also, the data show that it was possible to prepare alloys of the desired transition temperatures within reasonable limits. Metallographic studies revealed that the experimental Nitinol alloys in the as-cast condition contained several different phases in addition to the matrix. Photomicrographs illustrating the different types of metallurgical structures of the alloys are presented. The ingots prepared on this program are considered to be prime material for working into strip and wire for research use. (auth)

8130 ULTRASONIC STUDIES OF PHASE TRANSITIONS OF INTERSTITIAL IMPURITIES IN VANADIUM AND TANTALUM SINGLE CRYSTALS. Smith, Robert Emery. St. Louis; Washington Univ. (1969). 67p.

Thesis.

Anomalies in the thermal expansion and in the elastic constants of vanadium crystals in the range 180 to 260°K were studied in detail experimentally. A theory is proposed in which the system of vanadium crystal with interstitial impurities is taken to be thermodynamically equivalent to a solution. A study of precipitation from such a solution indicates that many physical properties of the vanadium system must be linear functions of the amount of impurity "precipitate." The solubility curve for hydrogen in vanadium is inserted into the precipitation theory and extraordinary agreement between theory and experiment is obtained. Nuclear acoustic resonance in tantalum single crystals was studied experimentally in the temperature range 50 to 300°K. Several large maxima in the linewidth and an anomaly in the low-temperature lineshape are discussed with the aid of an extension of the precipitation theory proposed for vanadium. (Diss. Abstr.)

8131 UPORYADOCHENIE ATOMOV I EGO VLIYANIE NA SVOISTVA SPLAVOV. SBORNIK SODERZHIT MATERIALY SOVESHCHANIYA, SOSTOYAVSHEGOSYA V KIEVE V MAE–IYUNE 1966 G. (Ordering of Atoms and Its Effects on Properties of Alloys. Conference on Metal Physics Held in Kiev, May–June, 1966). Svechnikov, V. N. (ed.). Respublikanskii Mezhvedomstvennyi Sbornik, Seriya Metallofizika, Vypusk 20. Kiev; Izdatel'stvo Naukova Dumka (1968). 264p. (CONF-660581).

Fifty-two papers are included on various factors influencing ordering processes in alloys. The effects of radiation on ordering in alloys are also discussed. Theoretical studies were made on the effects of atomic ordering on the physical properties of the alloys studied. Thermal oscillations of lattices, crystalline structure, and constitution diagrams were analyzed using various methods including Moessbauer effects. Titanium, zirconium, hafnium, niobium, and molybdenum sub-oxides were studied in addition to extensive studies on ferromagnetic and antiferromagnetic materials. (R.V.J.)

8132 AUTORADIOGRAPHIC TECHNIQUES FOR CONTROL OF METALLURGICAL PROCESSES. Sanchez, Wladimyr (Instituto de Energia Atomica, Sao Paulo, Brazil). Metalurgia (Sao Paulo); 24: 715-20(Sep 1968). (In Portuguese).

The autoradiography technique offers great advantages in the study of alloys, particularly of those in which the different metal constituents are not uniformly distributed but tend to segregate into small regions of high concentration. A simple method of macroautoradiography having a high resolution to get quantitative measurements was developed to investigate problems concerning the distribution of uranium and other active elements in metal specimens. On the autoradiographs obtained the blackening produced by the alpha and beta radiation exposure is measured using a microphotometer. By comparison of the photographic densities the distribution of uranium on Al–U–Si alloys was studied. Illustrations are presented of the behavior of uranium distribution in Al–U–Si alloys. (auth)

8133 STRUCTURE OF OPTICAL PROPERTIES OF CO-EVAPORATED NOBLE METAL–RARE EARTH ALLOY FILMS. Tsuboi, Yasusi. Philadelphia; Univ. of Pennsylvania (1968). 192p.

Thesis.

The thin film technique of co-evaporation was used to extend the solid solubility of Er in noble metals. The study was conducted to experimentally confirm the extension of the terminal solid solubility of co-evaporated Au-Er and Cu-Er alloys, and to investigate the electronic band structure and Fermi level of the extended alloys by interpreting the measured optical reflectivity in terms of intraband and interband transitions. Cu-Er and Au-Er alloys were fabricated by the simultaneous evaporation of the constituents onto glass substrates. X-ray and electron diffraction studies confirmed that the Er solubility in Au was extended from the equilibrium 5.7 atomic % Er to approximately 13.0 atomic % Er while no extension was observed for the case of Cu-Er alloys. Beyond 13.0 atomic % Er the as-deposited Au-Er films were amorphous and upon annealing transformed into a crystalline alloy. The lattice constant, particle size and strain were determined as a function of Er concentration, using the Fourier and integral breadth analysis. Optical reflectivity of the extended Au-Er single-phase alloy films at normal incidence was measured from the ultraviolet to the infrared region, and a Kramers-Kronig analysis was performed to obtain the frequency dependent complex dielastic constants. Using this calculated dielectric constant in the intraband transition region, the optical mass and relaxation time of conduction electrons were determined as a function of composition. The plasma resonance at 2.55 eV was also studied. The dielectric constant behavior in the interband transition region indicated that the conduction band in Au-Er alloys moves slightly downward in energy with respect to the d-band, while the Fermi level remains constant with respect to the d-band upon alloying. (Disser. Abstr.)

8134 THE PHASE COMPOSITION AND STRUCTURE OF NICKEL–ALUMINUM ALLOY CATALYSTS WITH ADDITIONS OF TITANIUM AND ZIRCONIUM. Bizhanov, E. B.; Sokol'skii, D. V.; Khisametdinov, A. M.; Omarov, A. K.; Ongarbaev, S. O. Tr. Inst. Khim. Akad. Nauk Kaz. SSR; 22: 127-37(1968). (In Russian).

X-ray, metallographic, and chemical methods, as well as measurements of total hardness and the microhardness of phases, were used to study the phase composition and structure of catalyst alloys, Ni–50% Al, with or without Ti and Zr additions. In the preparation of catalysts, leaching of the alloys converted the Ni_2Al_3 and $NiAl_3$ phases into finely crystalline Ni with a fcc lattice. The presence of Ti and Zr additions had some effect on the structure of the Ni. (Referativnyi Zh.)

8135 STEREOMETRIC ELECTRON METALLOGRAPHY ON WC–Co ALLOYS. Hillnhagen, Emil; Willbrand, Juergen (Fried-Krupp GmbH, Essen). Prakt. Metallog.; 6: 135-44(Mar 1969). (In German and English).

Experiments were carried out using ion-etching to reveal the structure of hard metal alloys, especially for stereometric electron microscopy. The results showed that, particularly for WC-Co alloys, the structure was correctly reproduced and that the phase boundaries were clearly recognizable. Polishing defects were also removed. The linear analytical measurements on experimental alloys with different WC grain sizes and Co contents were not carried out on micrographs but directly in the electron microscope. It was found that the grain size distribution was not always logarithmically normal and that the continuity depended not only on the Co content but also on the WC grain size. (auth)

8136 CONSTITUTION DIAGRAM OF Fe–Sc. Naumkin, O. P.; Terekhova, V. F.; Savitskii, E. M. Izv. Akad. Nauk SSSR, Metal.; No. 3, 161-5(May-Jun 1969). (In Russian).

The phase diagram of Fe–Sc was constructed and Fe_2Sc and $FeSc_3$ were revealed. During the interaction of iron with rare earth metals, the quantity of chemical compounds increased depending on the number of 4f-electrons in the rare earths. (tr-auth)

8137 ROENTGENOGRAPHIC STUDY OF Hf–Si SYSTEM IN REGION OF 37 TO 65 AT. PERCENT Si. Karpinskii, O. G.; Evseev, B. A. Izv. Akad. Nauk SSSR, Metal.; No. 3, 166-9(May-Jun 1969). (In Russian).

The intermediate phases in the Hf–Si system were studied roentgenographically at 37 to 65 at. % Si for Hf_5Si_3, Hf_3Si_2, Hf_5Si_4, HfSi, and $HfSi_2$. The dimensions of the elementary cells of these compounds and the coordinates of atoms of Hf and Si in their lattices were determined. The complete crystal-chemical similarity between the hafnium silicides studied and the corresponding silicides of zirconium were established. (tr-auth)

8138 NIOBIUM–HAFNIUM SYSTEM. Alekseenko, G. K.; Aleksandrova, L. N. Izv. Akad. Nauk SSSR, Metal.; No. 3, 170-2(May-Jun 1969). (In Russian).

By analysis of published data and experiments, it was established that two single-phase regions of solid solutions exist in the system Hf–Nb. One occurs on the basis of body-centered cubic lattice and the other occurs on the basis of hexagonal densely-packed lattices of α hafnium and two-phase region of α plus β. It was observed that the phase boundary is a function of oxygen and nitrogen content in the alloys. (tr-auth)

8139 X-RAY STRUCTURE INVESTIGATION OF ALLOYS OF PART OF La–Cu–Al SYSTEM. Zarechnyuk, O. S.; Emes-Misenko, E. I.; Malinkovich, A. N.; Gabrusevich, V. V. Izv. Akad. Nauk SSSR, Metal.; No. 3, 173-5(May-Jun 1969). (In Russian).

Studies were made on 73 ternary alloys of the La–Cu–Al system with a lanthanum content of from 0 to 33.33 at. % by x-ray structure analysis. The isothermal cross section was constructed of the part of the system studied at 400°C. The three ternary compounds established in the region studied were $LaCu_2Al_{10}$ of the $ThMn_{12}$ structure-type, $LaCu_{0.5\to1.0}Al_{3.5\to3.0}$ of the $BaAl_4$ structure-type, and $LaCu_{5.5\to10.0}Al_{7.5\to3.0}$ of the $NaZn_{13}$ structure-type. The solid solution of Al in $LaCu_5$ with the maximum content of Al at 45 at. % was established. The phases with Al-base were in equilibrium with solid solution. (tr-auth)

8140 PHASE DIAGRAMS AND OXIDATION OF Nb–Mo–Cr ALLOYS. Adamova, A. S.; Grigor'ev, A. T. Izv. Akad. Nauk SSSR, Metal.; No. 3, 176-80(May-Jun 1969). (In Russian).

The niobium angle of the phase diagram of the ternary system Nb–Mo–Cr was studied at the cross section Mo–$NbCr_2$. The polythermal sections were constructed for the ratio of molybdenum to chromium of 1 to 3 and 1 to 1 and for Nb–Cr with the constant content of Mo 10, 20, 30, 40, and 50 wt %. The existence of α-solid solution was determined. The oxidation of Mo–Cr alloys with alloys containing 10 to 15 wt % of Mo plus Cr were studied in air at 650°C for 40 hr. The slowest oxidation rate occurred in Nb + 2.00 % Mo + 2.00 % Cr, Nb + 3.75 % Mo + 1.25 % Cr, and Nb + 5.25 % Mo + 1.75 % Cr. (tr-auth)

8141 INVESTIGATION OF SYSTEMS $TaCr_2$–$ZrCr_2$ AND $TaCr_2$–$NbCr_2$. Budberg, P. B.; Alisova, S. P. Izv. Akad. Nauk SSSR, Metal.; No. 3, 181-3(May-Jun 1969). (In Russian).

The alloys of $TaCr_2$–$ZrCr_2$ and $TaCr_2$–$NbCr_2$ sections of the ternary system were studied by thermal and x-ray analyses. It was found that these sections are quasi-binary. The constitution diagrams of $TaCr_2$–$ZrCr_2$ and $TaCr_2$–$NbCr_2$ are characterized by continuous parallel solid solutions between the isomorphous modifications of compounds. (tr-auth)

8142 SOLUBILITY OF NEODYMIUM AND ALUMINUM IN SOLID MAGNESIUM. Padezhnova, E. M. Izv. Akad. Nauk SSSR, Metal.; No. 3, 196-200(May-Jun 1969). (In Russian).

Alloys of the Mg–Nd–Al system with a content of up to 7 wt % Nd and 15 wt % Al were studied by microstructural analysis and microhardness measurements. It was found that the solid solution phases such as Mg_9Nd and $Mg_{17}Al_{12}$ were in equilibrium with magnesium. Two isothermal cross sections at 400 and 200°C were constructed. The compositions of solid solutions which respond to the maximum combined solubility of the neodymium and aluminum in solid magnesium were determined. (tr-auth)

8143 DEFORMATION TEXTURE AND THE RECRYSTALLIZATION OF MONOCRYSTALS OF MOLYBDENUM. Mochalov, G. A.; Evstyukhin, A. I.; Emelyanov, V. S.; Rusakov, A. A.; Oplesnin, B. A. (Moscow Engineering Physics Inst.). Fiz. Metal. Metalloved.; 27: 499-503(Mar 1969). (In Russian).

The complex deformation texture (111) (110) plus (001) (100) was formed by two rolling methods on Mo monocrystals (110) (110) in the (110) direction. The recrystallization of rolled monocrystals of Mo (110) (110) produced the complex texture (111) (112) plus (001) (100) by rotating the main component. Rolling had a significant effect on the deformation texture of Mo (001) (110) monocrystals. The texture identification of the recrystallization of rolled Mo monocrystals (001) (110) was complicated by the presence of the coarse structure and its dependence on the previous plastic deformation. (tr-auth)

8144 DISLOCATION STRUCTURES OF MOLYBDENUM DEFORMED BY HYDROEXTRUSION. Buinov, N. N.; Karakhanyan, R. A.; Romanova, R. R.; Rakin, V. G.; Shmatov, V. T.; Rodionov, K. P.; Bulychev, D. K. (Inst. of Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 27: 509-15(Mar 1969). (In Russian).

The dislocation structure of molybdenum deformed by hydroextrusion was studied by the use of electron microscopic thin foils. Studies of deformation (10 to 70%) indicated that the increased plasticity was related to the increased degree of ordering of dislocation and volume reduction of cells. Formation of very fine strongly disoriented subgrains (during 70 and 80% deformation) increased the plasticity of Mo. (tr-auth)

8145 CHANGE OF MECHANICAL PROPERTIES AND DISLOCATION STRUCTURES OF DEFORMED MOLYBDENUM ALLOYS DURING ANNEALING. Girshov, V. L.; Ivashchenko, R. K.; Kaverina, S. N.; Mil'man, Yu. V.; Postnov, L. M.; Trefilov, V. I. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved.; 27: 516-23(Mar 1969). (In Russian).

During annealing of deformed molybdenum at 1100 to 2000°C with additions of carbon, titanium, and zirconium, dispersed phases of different morphology were formed. In the low temperature range, annealing was related to the process of elimination of grain structures and was accompanied by an increase in stability. (tr-auth)

8146 AUTOION MICROSCOPY OF W–1 PERCENT Gd_2O_3. Suvorov, A. L.; Kuznetsov, V. A. (Moscow Inst. of Physics and Tech.). Fiz. Metal. Metalloved.; 27: 566-9(Mar 1969). (In Russian).

Crystallographic stability of alloys with a low impurity content (W–1% Gd_2O_3) was studied using electric field evaporation method for identifying the ion images of impurity atoms. (R.V.J.)

Radiation Effects

Refer also to abstract 8526.

8147 (AECL-3370) COMPARISON OF TRANSITION TEMPERATURES INDICATED BY CHARPY V-NOTCH AND SUB-SIZE IZOD IMPACT SPECIMENS FOR IRRADIATED 3 1/2 PERCENT AND 9 PERCENT NICKEL STEELS. Watson, M. B.; Wotton, B. L. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Oct 1969. 20p. Dep. CFSTI (U. S. Sales Only). AECL $0.50.

Sub-size Izod specimens and full-size Charpy V specimens were impact tested for comparison. Nickel steels were chosen for a comparative study. One, a 3½% nickel steel, was a material of construction in the end shields of the Douglas Point reactor. The other, a 9% nickel steel, is of interest because of its lower nil ductility temperature (NDT) before irradiation. Impact specimens of both steels were irradiated simultaneously at temperatures below 120°C with fast neutrons to a fluence of 2.5×10^{19} n/cm² greater than 1 MeV. The post-irradiation transition temperature of the 3½% nickel steel was 85 and 170°C, as indicated by sub-size and full-size specimens respectively. The shift in transition temperature (ΔTT) set by the sub-size specimens was 30°C less than that set by the full-size. A similar comparison of the 9% nickel steel results indicated the difference in ΔTT was reduced to about 15°C. The irradiated 9% nickel steel maintained its lower NDT. (auth)

8148 (AECL-3457) METALLURGICAL EXAMINATION OF A COLD-WORKED ZIRCALOY-2 PRESSURE TUBE IRRADIATED IN THE U-2 LOOP. Langford, W. J. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Oct 1969. 34p. Dep. CFSTI (U. S. Sales Only). AECL $1.00.

A cold-worked Zircaloy-2 pressure tube of the type now in the Douglas Point Reactor was irradiated in the NRU reactor for 11,000 hours at 280°C under 14,000 psi hoop stress. Maximum integrated neutron dose was 1.2×10^{21} n/cm² (>1 MeV). Examination of the tube showed that its strength, defect tolerance, corrosion rate, and hydrogen pickup were consistent with requirements for a pressure tube life of 30 years. (auth)

8149 (AERE-R-5944(Vol.1), pp 205-13) TEMPERATURE DEPENDENCE OF DISLOCATION PINNING IN ELECTRON IRRADIATED COPPER. Keefer, D. W. (Atomics International, Canoga Park, Calif.).

The effects of irradiation temperature on the nature of dislocation pinning in electron irradiated copper were investigated. A model of enhanced pinning is proposed based on modulus and internal friction measurements which indicate that there are two active dislocation components referred to as soft and hard. (J.R.D.)

8150 (AERE-R-5944(Vol.1), pp 214-25) CHANGES OF ULTRASONIC ATTENUATION DUE TO DISLOCATION PINNING AFTER GAMMA IRRADIATION IN PURE COPPER. Winterhager, P.; Luecke, K. (Technische Hochschule, Aachen (West Germany). Institut fuer Allgemeine Metallkunde und Metallphysik).

Measurements of ultrasonic attenuation after irradiation at 220°K and subsequent annealing reveal two pinning stages centered at about 260 and 350°K. The activation energies found for these stages are 0.69 ± 0.05 eV and 1.45 ± 0.1 eV respectively. It is believed that both stages are due to vacancies. (auth)

8151 (AERE-R-5944(Vol.1), pp 239-54) ULTRASONIC ATTENUATION IN LEAD DURING AND FOLLOWING GAMMA IRRADIATION BETWEEN 260° AND 300°K. Lenz, D.; Luecke, K. (Technische Hochschule, Aachen (West Germany). Institut fuer Allgemeine Metallkunde und Metallphysik).

The ultrasonic attenuation has been measured in a Pb single crystal during and following γ-irradiation in the room tempera-

ture range. The results have been analyzed in terms of the Granato–Luecke theory of dislocation resonance damping. The dislocation pinning observed can be rationalized by the superposition of a constant arrival rate of irradiation produced pinning points from the lattice to the dislocations and two first order depinning processes, the activation energies of which are 0.76 ± 0.69 eV and 1.22 ± 0.04 eV respectively. (auth)

8152 (AERE-R-5944(Vol.2), pp 547-65) IRRADIATION GROWTH AND IRRADIATION ENHANCED CREEP IN f.c.c. AND b.c.c. METALS. Buckley, S. N. ([Atomic Energy Research Establishment, Harwell (England)]).

Observations of the role of dislocations in the dimensional stability of metals in radiation environments are reported. Models of cubic metal radiation growth are presented along with theories relative to radioinduced creep. (J.R.D.)

8153 (AERE-R-5944(Vol.3), pp 762-77) INFLUENCE OF RADIATION INDUCED DEFECTS ON THE PLASTIC FLOW PROPERTIES OF TUNGSTEN. Moteff, J.; Rau, R. C. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs).

Results of studies on commercially pure (99.98%) polycrystalline tungsten irradiated at reactor ambient (~70°C) temperatures to different fast (E > 1 MeV) neutron fluences show that three prominent point defect recovery stages occur above room temperature at approximately 0.15, 0.22, and 0.31 metal melting temperature (T_m). The defect responsible for the 0.22 and 0.31 T_m recovery stages contribute to the further hardening (thermal hardening) of specimens when tensile tested at 240°C (0.14 T_m). The observed hardening appears to be related to the presence of vacancy and interstitial clusters and/or loops and shows good correlation with the expression $\Delta t = \alpha\ (\mu b/L)$ where α is determined to be approximately equal to 1/5. Transmutation products (rhenium and osmium) contribute to the hardening of neutron irradiated tungsten when creep tested within the temperature range $0.35 < T < 0.5\ T_m$. The observed hardening shows good correlation with the expression $\Delta t = k(\phi_{fs})^{\frac{1}{2}}$ and is consistent with theories of solid solution hardening in dilute alloys. (auth)

8154 (ANL–7624) THE EBR-II MATERIALS-SURVEILLANCE PROGRAM. I. PROGRAM AND RESULTS OF SURV-1. Greenberg, Sherman (comp.) (Argonne National Lab., Ill.). Sep 1969. Contract W-31-109-eng-38. 40p. Dep. CFSTI.

Eight subassemblies containing 15 alloys used in the primary system of EBR-II, and shield graphite canned in Type 304 stainless steel are being irradiated in the EBR-II core at 700°F for varying periods of time and neutron dosage. Most of the alloy specimens are exposed directly to reactor sodium, and the remainder are sealed in helium. The alloys include aluminum bronze; Stellite 6B; Inconel X-750; T-1 tool steel; beryllium copper; Types 304, 347, 416, and 420 stainless steel (the Type 304 in four variations); Type 17-4 PH stainless steel; and tantalum. The first subassembly (SURV-1) has been removed, and examined after 671 days in the reactor and an estimated average fluence of 3×10^{19} n/cm^2 at energy levels >0.82 MeV. Of the materials exposed, only the beryllium copper and tantalum experienced appreciable weight loss, and thus appear to be unsuitable for use in contact with sodium under the conditions of the test. Types 304 and 347 stainless steel and the graphite assemblies experienced no significant changes in mechanical or physical properties. The other materials experienced appreciable changes in mechanical properties and/or metallurgical structure, but in the absence of thermal-effects control samples, the relative importance of the effects of neutron dosage and long exposures at reasonably elevated temperature cannot be established conclusively for these materials. Ample metallurgical evidence exists, however, to indicate that these materials could experience long-term thermal effects such as annealing, aging, and overaging. (auth)

8155 (CEA-R-3772) POINT DEFECTS IN NICKEL. Peretto, Pierre (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1969. 142p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Grenoble Univ., France.

The defects in electron irradiated nickel (20°K) and neutron irradiated nickel (28°K) are studied by simultaneous analysis using the magnetic after-effect, electron microscopy, and electrical resistivity recovery. Zone refined nickel (99.999%) which, for some experiments, is alloyed with a small amount of iron (for example 0.1% Fe) is used. The temperature dependent electrical recovery may be divided in four stages. The substages I_B (31°K), I_C (42°K), I_D (57°K) and I_E (62°K) of stage I are due to the disappearance of single interstitials into vacancies. The interstitial defect has a split configuration with a migration energy of about 0.15 eV. In the close pair which disappears in stage I_B the interstitial is found to be in a 3rd neighbor position while in stage I_D it is near the ⟨110⟩ direction from the vacancy. In stage I_E there is no interaction between the interstitial and the vacancy. The stage II is related to more complicated interstitial defects: di-interstitials for stage II_B (84°K) and larger interstitial loops for the following substages. The loops may be seen by electron microscopy. Impurities can play the role of nucleation centers for the loops. Stages III_A (370°K) and III_B (376°K) are related to two types of di-vacancies. During stage IV (410°K) the single vacancies migrate. Vacancy type loops and interstitial type loops grow concurrently and disappear at about 800°K as observed by electron microscopy. (auth)

8156 (CONF-670533–, pp 68-83) FRACTOGRAPHIC STUDY OF HELIUM-INJECTED 304 STAINLESS STEEL. Rhodes, C. G. (North American Aviation, Inc., [Thousand Oaks], Calif. Research Center); Pard, A. G. (Atomics International, Canoga Park, Calif.).

Tensile specimens of 304 stainless steel were irradiated with alpha particles to simulate helium generation which occurs in stainless steel during neutron irradiation. Samples containing 1×10^{-5} and 3×10^{-3} atom percent helium, as well as control samples containing no helium, were tensile tested at 1000, 1200, and 1400°F subsequent to irradiation. Replicas of the fractured surfaces examined in the electron microscope revealed a shear-rupture type failure in the samples tested at 1000°F. The failure at 1200°F was a mixture of shear-rupture type, quasi-cleavage type, and intergranular separation, the latter two modes becoming more evident with increasing helium content. Extensive thermal etching occurred on the fracture surfaces of samples tested at 1400°F. However, the general appearances of the fractures indicate that the helium-containing samples failed by intragranular separation, whereas the control sample failed by a mixture of inter- and intra-granular fracture. Also included in the study were replicas of polished surfaces parallel to the tensile axis and transmission electron microscopy of thin foils. (auth)

8157 (CONF-670533–, pp 216-29) CORRELATION OF MICROSTRUCTURE WITH MECHANICAL PROPERTIES OF IRRADIATED TUNGSTEN. Rau, Robert C.; Moteff, John; Ladd, Robert L. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation).

Transmission electron microscopy has been used to study the microstructure of mechanically tested polycrystalline tungsten which had been irradiated to fast (E > 1 MeV) neutron fluences ranging from 8.5×10^{17} to 1.5×10^{21} n cm^{-2}. A fluence threshold exists between 5.9×10^{18} and 3.8×10^{19} n cm^{-2} (E > 1 MeV), above which distinct defect cluster formation occurs. These clusters appear to contribute to the hardening of the material, leading to embrittlement in tensile specimens tested at 400°C. The microstructure of irradiated tungsten creep-rupture tested at 1100°C showed the presence of distinct dislocation loops, thought to result from interstitial aggregation. Although the microstructural features observed in irradiated tungsten appear to be related to fast (E > 1 MeV) neutron fluence rather than thermal neutron fluence, the irradiation induced strengthening observed at 1100°C shows better correlation with thermal neutron fluence. The presence of rhenium and osmium atoms produced by thermal neutron transmutation reactions is believed to account for the property changes at 1100°C. (auth)

8158 (GA–9383) FISSION PRODUCT RELEASE MEASUREMENTS ON TRISO FUEL PARTICLES IRRADIATED IN CAPSULE P-13F. Adams, C. C.; Langer, S.; Bell, W. E.; Burnette, R. D.; Graves, J. N.; Allen, C. L.; Zawacki, R. (Gulf General Atomic, Inc., San Diego, Calif.). 22 Oct 1969. Contract AT(04-3)-633. 55p. Dep. CFSTI.

A review of metallic fission product release data for TRISO particles irradiated in the P-13F capsule indicates that these samples withstood fuel burnup of up to 13% FIMA with very little degradation of the SiC barrier coatings. The high incidence of initially defective particles in some of the samples probably accounted for the major amount of metallic fission product release observed (approximately 10^{-3} fractions) for both the unirradiated and irradiated particles tested. The fuel contamination of the outer pyrolytic carbon (PyC) layers contributed to a lesser degree (approximately 10^{-5} fractions), and the intrinsic release is probably even lower (less than 10^{-6} fractions). Irradiated (11% FIMA) PyC- and SiC-coated particles can withstand high temperatures (up to 2300°C for several hours) without coating failure. (auth)

8159 (GEMP–716) HOT-MICROHARDNESS VALUES FOR METALS AND ALLOYS (IRRADIATED AND NONIRRADIATED). Kamphouse, J. L.; Myers, D. A.; Moteff, J. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). Dec 1969. Contract AT(40-1)-2847. 59p. Dep. CFSTI.

Data on the hot hardness of irradiated and unirradiated refractory metals and alloys of interest in nuclear technology are presented. The data are useful in determining temperature re-

gions in which pronounced changes occur in the plastic properties of these materials. (J.R.D.)

8160 (GEMP-725) HOT MICROHARDNESS PROGRAM, MICHRD. Baumgardt, N. R.; Kamphouse, J. L. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). 1 Dec 1969. Contract AT(40-1)-2847. 55p. Dep. CFSTI.

MICHRD is a FORTRAN IV program which was written for the GE-635 computer. The program computes the Vickers Pyramid Number, VPN, and, when an "irradiated" and a control specimen are being compared, the microhardness increment fraction, ΔH_f. The VPN is computed from filar micrometer eyepiece readings expressed in filar units, F.U. Both the VPN and ΔH_f may be plotted versus temperature. (auth)

8161 (N-69-37436) EFFECT OF NUCLEAR RADIATION AT CRYOGENIC TEMPERATURES ON THE TENSILE PROPERTIES OF TITANIUM AND TITANIUM-BASE ALLOYS. Younger, Charles L.; Haley, Fred A. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Sep 1969. 53p. (NASA-TN-D-5442). CFSTI.

An experimental investigation of the effects of reactor irradiation at 17°K on tensile properties of titanium and titanium-base alloys has been conducted in special test loops at the Plum Brook Reactor Facility. Commercially pure titanium, titanium-5 aluminum-2.5 tin, titanium-6 aluminum-4 vanadium, and titanium-8 aluminum-1 molybdenum-1 vanadium alloys showed significant increases in tensile strength and probable decreases in ductility following reactor exposures up to 10×10^{17} fast neutrons per square centimeter. The influences of impurities, preirradiation heat treatment, and postirradiation heat treatment on radiation damage were also evaluated. (auth) (STAR)

8162 GRAIN GROWTH AND NEUTRON IRRADIATION EFFECT IN Al-Li ALLOYS. Shiraishi, Kensuke; Fukaya, Kiyoshi (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo): 6: 663-4(Nov 1969).

Changes as a function of temperature observed in the grain diameter of neutron irradiated Al-Li alloys were measured and compared with those of unirradiated specimens. Grain growth was inhibited by He bubbles produced by a total neutron dose of about 7.2×10^{19} n/cm^2 at temperatures up to 550°C. Appreciable grain growth was observed in unirradiated specimens. (J.R.D.)

8163 A STUDY OF THE CRYSTAL STRUCTURE AND PROPERTIES OF METALS AND ALLOYS IRRADIATED BY NEUTRONS. Kritskaya, V. K.; Il'ina, V. A.; Kuznetsova, A. P.; Sharov, B. V. Sb. Tr. Inst. Metalloved. Fiz. Metal. Tsent. Nauch.-Issled. Inst. Chern. Met.; No. 59, 26-36(1968). (In Russian).

X-ray analyses were used to show that neutron bombardment causes the formation of elastically deformed micro-areas in Fe, Cr, Cu, Mo, and other lattices. The size of this elastic deformation depends on the nature of the atoms making up the crystal lattice, the type of impurities, and the initial condition of the irradiated specimen. A refinement of the grain substructure was found in some irradiated metals. In the majority of cases studied, the irradiation caused a change in the a lattice constant, the extent of this effect and the type of change varying with the metal. Measurements of x-ray scattering intensities from various crystallographic faces of α-Fe showed that anisotropy affected the distribution of radiation defects. Neutron irradiation has a significant effect on the the electrical resistance, ρ, of all the solid solutions that were studied with the size of ρ depending on the type of impurity atom. The recovery of ρ in deformed irradiated specimens takes place at lower temperature than in the non-irradiated specimens. The nature of the change of various mechanical properties of the alloys after neutron irradiation depends essentially on the type of alloying element and its concentration in the solid solution. (Referativnyi Zh.)

Ceramics and Cermets

Refer also to abstracts 8041-8043, 8045, and 8047-8049.

8164 PERFORMANCE OF RE-ENTRY THERMAL PROTECTION MATERIALS. Slaughter, J. I. (TRW Systems, Redondo Beach, Calif.). Pure Appl. Chem., Suppl.; 37-71(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

A status report is presented to show how further advances in ablation and reentry materials technology depend on advances in high-temperature technology. Problems requiring particular attention include coupled shear, ablation, and combustion effects in relation to surface recession phenomena. Improved high-temperature research and analytical tools are needed along with arc-heater plasma-flow characterization techniques for proper facility calibration and enhanced understanding of materials response. Emphasis should be placed on understanding high temperature vaporization and combustion processes at realistic reentry temperatures and pressures. Extrapolation of mass spectrometer data over large temperature and pressure ranges is too uncertain. Continued graphite oxidation and vaporization studies are needed for reentry applications. Such studies could be used to develop needed new high temperature research techniques and to understand the kinetics of the performance of high-temperature materials. Continued progress in high-temperature boundary-layer reaction rate chemistry is necessary in order to understand more completely the plasma-flow fields which surround a reentry vehicle. (auth)

8165 HIGH TEMPERATURE TECHNOLOGY. Proceedings of the Third International Symposium, Held at Pacific Grove, California, 17-20 September 1967. Supplement to Pure and Applied Chemistry. London; Butterworths (1969). 760p. (In French and English). (CONF-670935).

Fifty-three papers were presented at the symposium. A separate abstract was prepared for each of twenty-one papers. Five papers were previously abstracted in NSA as 21: 4085, 21: 43584, 22: 729, and 22: 749. Papers for which no abstracts were prepared are concerned with plasmas, lasers, chemical bonding, high temperature properties of solids, heat shielding, gas phase thermodynamics, solid-gas reactions, chemical processes, ionic systems, vaporization kinetics, and oxidation kinetics. (J.R.D.)

For abstracts of individual papers see: 8047-8049, 8060, 8061, 8102-8104, 8164, 8166, 8175, 8190-8193, and 8202-8207.

Corrosion and Erosion

Refer also to abstract 8061.

8166 OXIDATION OF URANIUM MONOCARBIDE AT HIGH TEMPERATURES AND LOW PRESSURES. Ervin, Guy Jr. (Atomics International, Canoga Park, Calif.). Contract AT(04-3)-701. Pure Appl. Chem., Suppl.; 409-20(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

The behavior of UC in oxygen at low pressure at temperatures above 1700°C is strikingly different from that at temperatures below 1700°C. In the lower temperature regime the material gains weight at a linear rate, and composite layer of UO_2 with an inner layer of UC_2 grows on the surface. In the higher temperature regime the sample loses weight at a linear rate and the surface remains bare. This behavior is consistent with the increasing relative stability of CO and decreasing relative stability of UO_2 at higher temperatures. Composition zones produced near the surface of the UC during oxidation are caused by carbon transport, inward at low temperature and outward at high temperature. These results illustrate the information that may be obtained by the use of low-pressure oxidation studies. (auth)

8167 INTERACTION OF GLASSY CARBON WITH ALKALI METAL VAPOURS. Halpin, M. K.; Jenkins, G. M. (University Coll. of Swansea, Wales). Proc. Roy. Soc. (London), Ser. A: 313: 421-31(11 Nov 1969).

It was shown by x-ray diffraction techniques that potassium vapor intercalates into nongraphitizing carbons, such as glassy carbon, to the maximum extent in recognizable stages. The resultant anisotropic expansions of the component crystallites of an isotropic aggregate are shown to be sufficient to cause violent disruption in larger pieces. Sodium vapor also causes disruption, but the temperatures required are considerably higher than for potassium. The onset of disruption in potassium vapor is characterized by a delay time which depends on the holding temperature and an activation enthalpy of about 1.4×10^5 J/mol. (auth) (UK)

Preparation and Fabrication

Refer also to abstracts 7621 and 8073.

8168 (BAW-3714-10) PREPARATION OF PLUTONIA-URANIA FUELS BY A SOL-GEL PROCESS. Carlson, R. V. (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). Nov 1969. Contract AT(30-1)-3714. 69p. Dep. CFSTI.

The overall objectives of the Gel-Addition contract are to develop an economical process for producing particulate plutonia-urania fast reactor fuels by sol-gel and related processes and to demonstrate the process through the pilot plant stage. One of the specific objectives of this program is to obtain the irradiation data required to qualify vibratory compacted particulate fuel for LMFBR use. The selected fuels consist of 20% PuO_2-80% UO_2

in the form of spherical particles, such as those prepared by an ORNL sol-gel process, and angular particles, such as those prepared from crushed pellets. In the sol-gel process for producing plutonia–urania fuels, separate sols of UO_2 and PuO_2 are prepared and blended in the appropriate ratio to obtain a mixed sol which is co-gelled into spherical particles and then fired to the mixed oxide. Nearly 2.2 kilograms of mixed-oxide microspheres were prepared with laboratory-scale equipment for the Gel-Addition irradiation program. The particles were prepared in two different diameter ranges –420 to 590 microns and less than 44 microns. In addition, two different uranium enrichments were used –0.26% and 20% ^{235}U. The preparation of the sol-gel fuel and the whole process is described. (auth)

8169 (DP-997) DEVELOPMENT OF TUBULAR UO_2 FUEL ELEMENTS FOR POWER REACTORS. Ferrara, A. S.; Holmes, W. G. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Jul 1969. Contract AT(07-2)-1. 82p. Dep. CFSTI.

A process was developed for fabricating tubular fuel elements with compacted cores of fused-and-crushed UO_2 in Zircaloy sheaths. Final core densities of greater than 90% of theoretical were obtained by a combination of vibration plus cold swaging. Irradiation of more than 135 tubes with compacted urania cores at test conditions that ranged up to 17,000 MWd/MtU peak exposure and 68 watts/cm peak thermal rating ($\int_{T_1}^{T_c} kd\theta$) indicated that such tubes should operate satisfactorily in a full-scale heavy-water-moderated power reactor to peak exposures of at least 20,000 MWd/MtU and peak thermal ratings of 30 watts/cm. Examination of 45 tubes irradiated in the Heavy Water Components Test Reactor indicated the following results. Less than 10% of the fission gas produced during irradiation was released in fuel tubes operating at low $\int kd\theta$ (below about 25 watts/cm); onset of columnar grain growth in the UO_2 core occurred at about 25 watts/cm and coincided with a sharp rise in the fractional release of fission gas. Release of nitrogen from impurities in fused UO_2 was substantially reduced by outgassing the UO_2 at high temperature in a vacuum or in hydrogen before irradiation. The outer sheath wrinkled in tubes with relatively low-density cores (82 to 87% of theoretical density) when operated at $\int kd\theta$ of 40–45 watts/cm; tubes compacted to 90% of theoretical density did not wrinkle when irradiated at 50 watts/cm. (auth)

8170 (JUL-615-RW) ON THE COATING OF SPHERICAL $(U, Th)O_2$ PARTICLES WITH PYROLYTIC CARBON BY METHANE DECOMPOSITION IN 1-INCH FLUIDIZED BED. Gyarmati, E.; Nickel, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Aug 1969. 41p. (In German). Dep. CFSTI (U. S. Sales Only).

Studies were made on the deposition of pyrolytic carbon on $(U,Th)O_2$-fuel kernels in a 1-inch-fluidized bed varying the methane-concentration at 5, 22, and 36 volume % and the deposition temperature at 1300 to 1900°C, and the physical properties of the deposited pyrolytic carbon. The behavior of spherical particles was observed in a fluidized bed with special regard to the viscosity of argon–hydrogen mixtures. The data necessary for the deposition process and for its evaluation are defined. It was found that pyrocarbon with laminar structure resulted in deposition temperatures to 1400°C. Density and Bacon-Anisotropy Factor (BAF) decreased with increasing methane-concentration, whereas the crystallite size L_c and the efficiency decreased. Pyrocarbon with isotropic structure was deposited at temperatures ≥1400°C and methane-concentrations ≥15 volume %. A typical feature of this pyrocarbon species was the low orientation of the crystallites. With increasing temperature crystallite size, density and efficiency grew. At about 1500°C, density, crystallite size, and BAF reached a minimum. Pyrocarbon with granular or columnar structure resulted at temperatures ≥1500°C at methane concentrations ≤15 volume %. A significant feature of this structure was the granulation or the cone array of the deposited pyrocarbon. Density, crystallite size, and BAF increased with increasing temperature. (auth)

8171 PROCESS FOR PREPARING AN YTTRIA AQUASOL. Smith, J. G.; Fitch, F. T. (to U. S. Atomic Energy Commission). U. S. Patent 3,476,691. Nov. 4, 1969.

A process is described for preparing amorphous and crystalline yttrium oxide sols by mixing a substantially electrolyte-free hydrous yttria precipitate with water in a quantity of a strong mineral acid sufficient to adjust the pH to 6.5 to 7.5 followed by heating to form the amorphous yttria sol. The crystalline sol is formed by an additional heating step. (AEC)

8172 STUDY OF THE FABRICATION OF VERY HIGH DENSITY URANIUM DIOXIDE NODULES, REGULAR COURSE FRACTION FOR VIPAC FUEL. Flipot, A. J.; Barberis, P. M.; Mestdagh, G. (SCKCEN, Mol, Belgium). Energ. Nucl. (Milan); 16: 641-6(Oct 1969).

The automatic pelleting of UO_2 nodules of very high density and of small dimensions (from 1 to 3.5 mm) was studied and perfected. The introduction of additives and the method of granulation are described, together with the effects of the different sintering parameters. Pellets with a density of about 6 g/cm^3 give, after sintering one hour at 1600°C in hydrogen atmosphere, fired densities of 98 ± 0.5% T.D. A study on spheroidizing cylindrical pellets was also carried out. (auth)

8173 METHOD OF PRODUCING A NUCLEAR REACTOR FUEL ELEMENT. Ford, Lionel Houston (to United Kingdom Atomic Energy Authority). U. S. Patent 3,480,702. 25 Nov 1969. Priority date 26 May 1967, Great Britain.

A nuclear reactor fuel element comprises particles of ceramic fissile material, each having a coating of nonfissile ceramic material. The particles are contained in an outer ceramic container and the particles are bonded together in a region about each of their points of contact in the container by an individual bridge of a metal such that the interspaces between the particles are free of the metallic bonding material. The method of making the fuel element comprises the steps of overcoating the particles with a solid layer of metal, and then filling said ceramic container with the metal coated particles. The ceramic container and contained particles are heated to melt the metal coating on the particles so that the molten metal moves by capillary action to form individual bridges of the metal bonding said particles together in the region about each of their points of contact in the container. (Offic. Gaz.)

8174 REINFORCED COMPOSITE MATERIALS. Williams, Richard Mehlin; Warren, James Wyman (to Ducommun Inc.). British Patent 1,163,979. 10 Sep 1969. Filed 7 Mar 1967.

Reference is made to composite materials capable of withstanding high temperatures, such as may be employed as constructional materials for nuclear reactor and rocket nozzle purposes. The material described comprises carbonized organic fibers, forming a substrate, these fibers having coatings of a pyrolytic material, applied at a pressure of <1 atm., or by vapor deposition, the composite material having a density of between 20 and 125 lb/cu. ft. The pyrolytic material may comprise graphite, boron nitride, tantalum carbide, niobium carbide, zirconium carbide, hafnium carbide, silicon carbide, or Ta, W, Mo or Nb metal. The fibers may be orientated so that the material has anisotropic properties, and the composite may have a high temperature resisting filler disposed in the voids between the coating, so as to form a substantially impervious body. Manufactured articles may also have a gradually increasing density along a predetermined direction. A doping element may be provided to give a pyrolytic graphite alloy. Manufacturing methods are described. (UK)

8175 PREPARATION AND PROPERTIES OF REFRACTORY OXIDES FROM METAL–ORGANIC COMPOUNDS. Lynch, C. T.; Mazdiyasni, K. S.; Smith II, J. S. (Air Force Materials Lab., Wright-Patterson AFB, Ohio). Pure Appl. Chem., Suppl.; 393-408(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

The application of metal alkoxide decomposition to the synthesis of refractory oxide bodies with improved thermophysical properties is described. (J.R.D.)

8176 PROCESS FOR PREPARING CARBIDE REACTOR FUEL. (to Atomic Energy of Canada Ltd.). British Patent 1,173,952. 10 Dec 1969. Priority date 16 Feb 1966, Canada.

A process for densifying carbides for use as reactor fuel is given which consists of the application of pressure to low density preformed pellets of UC, ThC, or PuC or a mixture of the carbides while in an electrically insulated die, and passing an electric current through the pellet. The portion of the die in contact with the pellet consists of thorium oxide, zirconium oxide, beryllium oxide, magnesium zirconate, calcium zirconate, boron nitride, silicon nitride or aluminum nitride. The pellet is flame-spray coated with zirconium oxide. (J.C.W.)

8177 METAL CARBIDE AND BORIDE PRODUCTION. (to Carborundum Co.). British Patent 1,173,993. 10 Dec 1969. Priority date 4 May 1966, United States.

A method is described for the production of metal carbides or borides by carbothermic reduction. In this case B and Si are considered metals. The method allows a more complete interaction of the reactants upon firing, accompanied by a more effective control of stoichiometry and purity in the product. By employing source materials which are readily and economically available in a comparatively pure state, products of superior quality are produced. In the process, metal carbides and borides are produced in the form of powders rather than massive lumps. Production meth-

ods for the carbides of B, Mo, Si, U, V, and W and the borides of Mo, Ti, and Zr are given. (J.C.W.)

8178 PREPARATION OF COATED NUCLEAR FUEL PARTICLES FOR METALLOGRAPHIC STUDY. 2nd SUPPLEMENT. Boerner, Gudrun; Goergenyi, Tibor (Nuklear-Chemie und -Metallurgie GmbH, Wolfgang, Ger.). Prakt. Metallog.; 6: 172-9(Mar 1969). (In German and English).

Further developments in the technique of preparing metallographic sections from (Th, U)C_2 and (Th, U)O_2 particles coated with pyrolytic carbon are described. The metallographic preparative and microradiography techniques were extended to include particles with a silicon carbide intermediate layer. (auth)

8179 SINTERED URANIUM DIOXIDE. Elyard, Charles Anthony; Potter, Terence Jefferson (to Associated Electrical Industries Ltd.). British Patent 1,172,226. 26 Nov 1969. Filed 29 Sep 1966.

A process is described for the preparation of UO_2 for use as a reactor fuel, by which the product does not undergo columnar growth when subjected to steep temperature gradients at temperatures up to 2000°C and that the rate of release of dissolved Xe and Kr at these temperatures is lower than from normal ceramic UO_2. A small amount of CeO_2 (preferably 0.8 to 2 wt %) is incorporated in the UO_2. The UO_2 and CeO_2 may be mixed as powders, or a solution of a Ce compound may be added to the UO_2; in the latter case the resulting slurry is dried and the Ce compound converted to oxide. The ceramic fuel is fabricated from the resulting powder by conventional ceramic techniques. The powder may, for example, be die pressed, slip cast or entruded, and then sintered. The sintering may be performed in a reducing atmosphere, such as H_2, or in a neutral atmosphere, such as Ar, or in a slightly oxidizing atmosphere, such as steam. Subsequent firing in H_2 is necessary if sintering is performed in a neutral or oxidizing atmosphere, in order that the UO_2 does not contain excess oxygen. (UK)

8180 METHOD AND APPARATUS FOR THE FABRICATION OF NUCLEAR FUEL ELEMENTS. (to Westinghouse Electric Corp.). British Patent 1,173,030. 10 Dec 1969. Priority date 6 Nov 1967, United States.

A design is given for a nuclear fuel element with a high internal gas pressure and simple method for filling the fuel element with gas. The tubular sealed fuel element has plugged ends, a small cross-section axial opening formed in one plug and a fusible collar around the opening. The method and apparatus are described for loading the fuel, introducing the gas, positioning the electrode, and sealing the element. (J.C.W.)

8181 IMPROVEMENTS IN OR RELATING TO THE DRYING OF GRANULAR SOLID MATERIALS. (to SNAM Progetti S.P.A.). British Patent 1,174,945. 17 Dec 1969. Priority date 31 Jan 1966, Italy.

A continuous process is given for removing a liquid from a granular solid wet with the liquid. The wet solid material is admixed with an excess of dispersing liquid which is either completely or partially immiscible with the original liquid and capable of forming an azeotropic mixture of minimum boiling point. The admixture is introduced into one end of a reactor, heated to a temperature such that the liquids distill under partial reflux in the first part of the reactor and distill without reflux in the second part of the reactor. The original liquid is vaporized completely and exits from the inlet end of the reactor. The dispersing liquid is partially removed from the inlet end of the reactor. The solid material is removed from the other end of the reactor and is then further dried by baking to produce a material of desirable density. The method is advantageous for drying granular hydroxides and/or oxides of Pu, Th, and U for the production of spheroidal fuels for nuclear purposes. (J.C.W.)

Properties Evaluations

Refer also to abstracts 7426, 7483, 8038, 8092, and 8206.

8182 (AERE-M-2247) ESTIMATE OF THE SURFACE ENERGIES OF SOME METAL CARBIDES. Mortimer, D. A.; Nicholas, M. (Atomic Energy Research Establishment, Harwell (England)). Aug 1969. 10p. Dep. CFSTI (U. S. Sales Only).

Published surface energy values for several carbides were evaluated in the light of new contact angle data. Livey and Murray's values (AERE-M/R-1846(1956)) for TiC and VC were confirmed but their values for TaC and ZrC were inconsistent with the new data. Surface energy values for Cr_3C_2 and NbC are suggested. (auth)

8183 (ORNL-TM-2717) FUEL MIGRATION IN PYROCARBON-COATED PARTICLES. Morgan, M. T.; Hewette, D. M.; Long, E. L. Jr.; Sisman, O. (Oak Ridge National Lab., Tenn.). Nov 1969. Contract W-7405-eng-26. 94p. Dep. CFSTI.

Results are given on fuel migration and fuel-coating interaction as a result of irradiation and postirradiation anneals. Eight different batches of coated particles were studied, four containing UO_2 and four containing UC_2 as the fuel material. Irradiation-induced fuel-coating reaction was more extensive in the UC_2-fueled particles. Postirradiation heat treatment caused no appreciable extension of damage areas in particles of either type fuel. (auth)

8184 (ORNL-TM-2727) MECHANICAL BEHAVIOR OF ARTIFICIAL GRAPHITES. Greenstreet, W. L.; Smith, J. E.; Yahr, G. T.; Valachovic, R. S. (Oak Ridge National Lab., Tenn.). Dec 1969. Contract W-7405-eng-26. 46p. Dep. CFSTI.

Stress-strain behavior which is representative of nuclear-grade, or equivalent, graphites is described and discussed. Since cyclic loading test results provided important insight into the characteristics of graphite behavior, emphasis was placed on results of this type. Monotonic loading curves were also considered, and both stress versus longitudinal strain and stress versus lateral strain curves are given for monotonic and cyclic loading. The new results given in this report are combined with results published in the literature to provide a unified description of the observed behavior. (auth)

8185 (ORO-3782-1-A) THE GALVANOMAGNETIC PROPERTIES OF GRAPHITE IN THE TEMPERATURE RANGE 4-300°K AND PRESSURE RANGE 0-10,000 kg/cm². Annual Progress Report. Spain, Ian L. (Maryland Univ., College Park. Inst. for Molecular Physics). Oct 1969. Contract AT(40-1)-3782. 17p. Dep. CFSTI.

Experimental results at 77 to 300°K are summarized briefly, and problems with the apparatus are described. Chemical analysis of the graphite crystals is reported. Theoretical calculations of the galvano- and thermomagnetic tensor coefficients of graphite from energy band models are in progress. (D.L.C.)

8186 ISOTOPE EFFECT FOR CATION SELF-DIFFUSION IN CoO CRYSTALS. Chen, W. K.; Peterson, N. L.; Reeves, W. T. (Argonne National Lab., Ill.). Phys. Rev.; 186: 887-91(15 Oct 1969).

Diffusion of ^{60}Co in CoO crystals has been measured in the temperature range from 963 to 1638°C in air by the standard tracer-sectioning technique. The temperature dependence of the diffusion coefficient D is given by $D = (5.0 \pm 0.4) \times 10^{-3} e^{-(38,300 \pm 720)/RT} cm^2/sec$. The isotope effect for cation self-diffusion was determined by simultaneous diffusion of ^{55}Co and ^{60}Co tracers in CoO crystals. The strength of the isotope effect, defined by $E_{60} = [1 - (D_{60}/D_{55})]/[1 - (m_{55}/m_{60})^{1/2}] = f\Delta K$ was 0.582 ± 0.009, independent of temperature in the range from 1081 to 1411°C. This result is consistent with cation self-diffusion by a vacancy mechanism only, and $\Delta K = 0.746 \pm 0.012$. (auth)

8187 NEW METHOD OF MEASURING THERMAL CONDUCTIVITY. Schmidt, H. E.; Richter, J.; van den Berg, M. (Europaisches Institut fuer Transurane, Karlsruhe, Ger.). High Temp.-High Pressures; 1: 185-97(1969). (In German).

An absolute stationary longitudinal-heat-flow method for measuring the thermal conductivity of disc-shaped specimens of poor thermal conductors ($\lambda \leq 0.1$ W cm^{-1} deg^{-1}) is described. Heat flux through the specimen is controlled with the aid of adjustable electric heaters at the faces of the specimen, and determined from the power input. Measurements are reported on uranium oxide and plutonium oxide specimens, 6 mm in diameter and 1 mm thick, between room temperature and 850°C. Reproducibility of the results is better than within 5%, and the absolute error is less than 10%. (auth) (UK)

8188 HIGH-TEMPERATURE THERMODYNAMIC STABILITIES OF $Cr_{23}C_6$, Cr_7C_3 AND Ta_2C DETERMINED BY A TORSION-EFFUSION TECHNIQUE. Kulkarni, Avinash Dattatraya. Philadelphia; Univ. of Pennsylvania (1968). 129p.

Thesis.

The pressures of carbon monoxide gas in equilibrium with $Cr_{23}C_6$–Cr_2O_3–Cr; Cr_7C_3–Cr_2O_3–$Cr_{23}C_6$; and Ta_2C–Ta_2O_5–Ta have been determined by a torsion-effusion technique. Using these data, the following high-temperature free energy equations have been derived for $Cr_{23}C_6$, Cr_7C_3 and Ta_2C: $\Delta G_f^0, Cr_{23}C_6$ (±1250) = −72,030 (±2700) − 18.3T cal/g-mole (1150 to 1300°K) $\Delta G_f^0, Cr_7C_3$ (±500) = −32,680 (±1200) − 8.73T cal/g-mole (1100 to 1721°K) $\Delta G_f^0, Ta_2C$ (±300) = −47,090 (±2200) + 2.1T cal/g-mole (1740 to 1895°K). The following equation for the free-energy of formation of Cr_3C_2 has been calculated. $\Delta G_f^0, Cr_3C_2$ (±300) = 14,700 (±700) − 4.40T cal/g-mole (1306 to 1495°K). An isothermal phase diagram of Ta–Cr–C system at 1700°K has been constructed. Two possi-

ble mechanisms for the $Cr_{23}C_6-Cr_2O_3$ reaction have been discussed. (Disser. Abstr.)

8189 ELECTRIC CONDUCTIVITY AND DEFECT STRUCTURE OF CERIA–ZIRCONIA SOLID SOLUTIONS. Fehrenbacher, Larry Lee. Urbana, Ill.; Univ. of Illinois (1969). 98p.

Thesis.

The electrical properties of 22 mole % CeO_2-ZrO_2 tetragonal solid solution samples were investigated as a function of temperature and oxygen partial pressure over a range of 800 to 1400°C and 1 to 10^{-14} atmospheres. Direct alternating current conductivities, thermoelectric power, and transference number (Po_2 cell) measurements were supplemented by thermogravimetric and x-ray diffraction analyses. This ceria-zirconia solid solution exhibited a high pressure (10^0-10^{-7} Po_2) n-type conductivity region where the tetragonal phase was stable and a low pressure ($10^{-7}-10^{-12}$ Po_2) two-phase (pyrochlore $Ce_2Zr_2O_7$ and free ZrO_2) region where hole (p-type) conduction predominated. The pressure dependencies of conductivity and weight change for the high and low pressure regimes were $\sigma \propto Po_2^{-1/4}$, $\Delta W \propto Po^{-1/4}$ and $\sigma \propto Po_2^{1/4}$, $\Delta W \propto Po_2^{1/4}$, respectively. The difference in pressure dependences of σ and ΔW made the n conduction uninterpretable in terms of a simple, defect model. An electron hopping model consisting of charge transfer between cerous ion-oxygen vacancy pairs ($Ce\ V_0$)· and Ce + 4 ions was proposed. The p conduction region was interpreted as representative of the conductivity of free zirconia, the pyrochlore compound making no contribution. A zirconium vacancy-oxygen vacancy acceptor complex $(V_{Zr}\ V_0)''$ defect model satisfied the pressure dependency requirement for hole conduction. (Disser. Abstr.)

8190 A STUDY OF THE DIFFUSION OF RADIOACTIVE NUCLIDES IN MOLTEN SILICATES AT HIGH TEMPERATURES. Winchell, P.; Norman, J. H. (Gulf General Atomic Inc., San Diego, Calif.). Pure Appl. Chem., Suppl.; 479-92(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

Methods used to measure diffusion of radioactive nuclides in molten silicates are described. (J.R.D.)

8191 CARBIDES AS HIGH-TEMPERATURE STRUCTURAL MATERIALS. Hollox, G. E. (Martin Marietta Corp., Baltimore). Pure Appl. Chem., Suppl.; 257-64(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

Properties of single-crystal carbides are discussed and an evaluation of their prospects as structural materials is given. (J.R.D.)

8192 HIGH TEMPERATURE MECHANICAL PROPERTIES OF URANIUM COMPOUNDS. Beals, R. J.; Handwerk, J. H.; Dragel, G. M. (Argonne National Lab., Ill.). Pure Appl. Chem., Suppl.; 265-78(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

The dependence of maximum fiber stress on temperature, strain rate, composition, and physical characteristics of oxides, sulfides, and phosphides of uranium were investigated. (J.R.D.)

8193 EVAPORATION BEHAVIOR AND HIGH-TEMPERATURE THERMAL ANALYSIS OF SUBSTOICHIOMETRIC PLUTONIUM OXIDE IN THE COMPOSITION RANGE FROM O/Pu = 1.51 to 2.00. Ohse, R. W.; Ciani, V. (EURATOM, Karlsruhe, Ger.). Pure Appl. Chem., Suppl.; 365-75(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

Work to determine the vapor pressure minimum at the congruently evaporating composition in the single phase region O/Pu = 1.61 to 2.00 and in the region O/Pu = 1.51 to 1.61 is reported. An evaluation of the univariancy or bivariancy of the evaporation behavior is reported. (J.R.D.)

8194 AN EXPERIMENTAL INVESTIGATION OF HIGH-ELECTRIC-FIELD CURRENT TRANSPORT IN RARE EARTH METAL OXIDES. Fromhold, A. T. Jr. (Auburn Univ., Ala.). Phys. Status Solidi; 36: K129-32(1 Dec 1969).

The current–voltage characteristics of rare-earth-metal oxide films 300 to 6000 Å thick were studied following current–voltage cycles up to breakdown threshold. Films of La, Ce, Pr, Nd, Sm, Gd, Dy, Ho, Er, and Yb oxides were found to give satisfactory characteristics after such treatment. Possible rate-limiting current transport mechanisms were considered, and the thermal hopping model was found to give excellent fit to the experimental data. (D.L.C.)

8195 DEBYE TEMPERATURES OF SOME METAL MONOCARBIDES. Kempter, C. P. (Los Alamos Scientific Lab., N. Mex.). Phys. Status Solidi; 36: K137-9(1 Dec 1969).

Debye temperatures were calculated from elastic moduli for ZrC, HfC, NbC, and TaC and compared with these calculated from Lindemann's equation. Similar calculations and comparisons were also made for TiC, VC, MoC, UC, ThC, PuC, and WC. (D.L.C.)

Structure and Phase Studies

Refer also to abstracts 8135 and 8193.

8196 (CEA-R-3801) CONTRIBUTION TO THE STUDY OF THE URANIUM–OXYGEN–NITROGEN SYSTEM. Martin, Jean-Marie (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Sep 1969. 53p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Univ. of Grenoble, Faculte des Sciences, France.

Phase relations between uranium dioxide and nitroxides under a nitrogen pressure of one atmosphere were investigated. New types of nitroxides found include a UO_2 type with the formula $UO_{2(1-x)}\ N_{1.5x}$ where $0 < x < 0.65$, a U_2N_3 type with the formula $UN_{1.5(1-x)}\ O_{2x}$ where $0 < x < 0.2$, and a UN type with the formula UNO_x where $0 < x\ 0.15$. The range of existence of these nitroxides has been specified. A monotectoid reaction between UO_2 and U_2N_3 has been disclosed. The pseudo-binary character of the section $UO_2-U_2N_3$ is pointed out, as well as the existence of an eutectic reaction between UO_2 and UN (melting temperature circa 2500°C). The limiting compositions of the UO_2 and UN phases simultaneously in equilibrium with liquid uranium have been determined. (auth)

8197 (CONF-670533–, pp 16-22) METALLOGRAPHIC PROCESSING OF OXIDE SPECIMENS. Dvorak, James R. (IIT Research Inst., Chicago, Ill.); Domagala, Robert F. (Illinois Univ., Chicago).

Metallographic examination of annealed and quenched specimens was required during the course of a study of phase relations in the zirconia-scandia system. Although polishing was accomplished using rather conventional techniques, the somewhat inert properties of the oxides caused some problems. When a satisfactory etchant (hot phosphoric acid) was found, a suitable mounting material was needed to withstand the vigorous attack of the strong oxidizing reagent. Mineral-filled diallyl phthalate proved to withstand the etchant better than any of the other mounting materials which were examined. (auth)

8198 (CONF-670533–, pp 84-91) SOME PHASE EQUILIBRIA IN THE THORIUM–NITROGEN SYSTEM (A CONDENSATION). Benz, R.; Hoffman, C. G.; Rupert, G. N. ([Los Alamos Scientific Lab., N. Mex.]).

Thorium–Nitrogen phases revealed by equilibration under various conditions were investigated. The results are reported and summarized in a phase diagram. (J.R.D.)

8199 (CONF-670533–, pp 116-30) METALLOGRAPHIC PREPARATION OF PLUTONIUM–URANIUM NITRIDES AND CARBONITRIDES AND OF COATED PLUTONIUM OXIDE PARTICLES. Snider, R. H.; Stelz, R. R. ([Battelle Memorial Inst., Columbus, Ohio]).

Specimens of $(Pu_{0.3}U_{0.8})N$ were successfully prepared for purposes of determining their phase contents and densities. The procedure used in preparing these specimens consisted of mounting, grinding, polishing, and etching. Two swab etching techniques, which were utilized in this procedure, are described. Specimens of (Pu,U)CN were prepared by mounting, grinding, polishing, and etching to determine their microstructural features as related to the stoichiometry and carbon-nitrogen content. A method for electro-chemical etching of (Pu,U)CN is described. Coated PuO_2 particle materials were successfully prepared by mounting, grinding, and polishing to ascertain the thickness and quality of their coatings as well as to denote the relative density and character of the PuO_2 core material. A special technique employed to give preferred orientation of the particles in mount for purposes of determining the coating thicknesses of PuO_2 materials is described. (auth)

8200 (CONF-670533–, pp 152-61) REPLICAS FOR POROSITY DETERMINATION IN AS-SINTERED URANIUM DIOXIDE. Labranche, D. A.; Aqua, E. N. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.).

A replicating procedure was developed to determine the microporosity, i.e., visible pore fraction at 6000X, of as-sintered UO_2 pellets. Replicas from fractured and polished UO_2 pellets were made, and subsequently examined in the electron microscope. The steps necessary for the preparation of sound replicas are described and results on as-sintered pellets are presented. (auth)

8201 YTTRIA–STABILIZED ISOMETRIC PHASE OF ZIRCONIA. Sardi, Otto. Bloomington, Ind.; Indiana Univ. (1969). 74p. Thesis.

Experiments were conducted to find evidence for or against the occurrence of solid solutions of zirconia–yttria and to determine concentrations of yttria in stable phases in the system. The combination of x-ray diffraction, both film and diffractometer methods, x-ray diffractometer furnace, and petrographic microscope methods together with the quenching technique was employed. For the calculation of the lattice parameters and for the tabulation of the data, a Fortran IV computer program was written and run on a CDC 3600 computer. Both theoretical and experimental approaches have demonstrated that yttria is capable of reacting in the solid state with the tetragonal phase of zirconia and of converting it to the isometric stabilized phase. The degree of reaction depends on temperature and time. The stabilized zirconia has an oxygen deficient defect fluorite-type structure which shows continuous structural and compositional connections with the C-type rare earth structure of yttria. The presence of an intermediate compound is not required either from a structural or a compositional standpoint. A mixture of 4.99 mole % yttria in zirconia heated to 1000°C for 123 hours shows the presence of a small amount of stabilized zirconia phase. A greater degree of solid solution was observed with the same mixture heated to 1200, 1400, and 1700°C for 86, 48, and 8 hours, respectively. If the yttria concentration is increased to 15 mole %, an almost complete temporary stabilization is reached at 1400°C. The mixtures of 4.99 mole % and 6.96 mole % yttria heated to 1700°C and mercury quenched yielded mainly stabilized zirconia. A complete stabilization is attained with 11.53 mole % yttria at 1700°C; however, it is believed that approximately 8 mole % yttria would produce the same result. The one-phase stabilized zirconia persists up to 39.99 mole % yttria at 1700°C. The two-phase region at 1700°C, where stabilized zirconia and yttria solid solution coexist, extends from 39.99 mole % yttria to some concentration above the maximum used (54.99). Other two-phase regions, observed with 4.99 mole % yttria (preheated to 1700°C), are the tetragonal phase and the stabilized zirconia at 900°C; the monoclinic phase and the stabilized zirconia at room temperature. (Disser. Abstr.)

8202 CHEMICAL BONDING OF REFRACTORY PHASES. Nowotny, Hans (Univ., Vienna). Pure Appl. Chem., Suppl.; 191-200(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

The state of development of theories concerning chemical bonding of refractory phases particularly carbides and nitrides is compared with results obtained in crystal chemistry research. (J.R.D.)

8203 LANTHANUM CHROMITE: NEW PROPERTIES. Anthony, A. M. (CNRS, Orleans-La-Source, France); Benezech, G.; Cabannes, F.; Faucher, M.; Foex, M.; Loc, Vutien; Yerouchalmi, D. Pure Appl. Chem., Suppl.; 214-33(1969). (In French and English).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

Results of studies on the Cr_2O_3–La_2O_3 system are presented along with data and information on the electric, thermal, and structural properties of $LaCrO_3$. (J.R.D.)

8204 HIGH TEMPERATURE PHASE STUDIES WITH A SOLAR FURNACE. Noguchi, Tetsuo (Government Industrial Research Inst., Nagoya, Japan). Pure Appl. Chem., Suppl.; 235-47(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

Results of temperature and emissivity measurements in a solar furnace are reported. Measurements of single oxide freezing points and measurements of liquidus curves in binary systems with liquid-solid and solid-solid reactions to establish phase relations at high temperatures are also reported. (J.R.D.)

8205 ORIENTATED GROWTH AND DEFECT STRUCTURES OF SINGLE CRYSTAL TRANSITION METAL DIBORIDES. Haggerty, J. S.; Wenckus, J. F.; Lee, D. W. (Arthur D. Little, Inc., Cambridge, Mass.). Pure Appl. Chem., Suppl.; 547-55(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

The crystal synthesis procedures have been used successfully to produce ZrB_2 and HfB_2 single crystals of a higher quality than previously available. The high pressure capability has been a principal factor in controlling the stoichiometry of the diborides. Chemically the crystals are of very high quality. Both are in excess of 99.8% purity. A minor fcc second phase is the major degrader to their quality. Significant progress has been made in identifying the precipitate which is an essential, preliminary step in its elimination. (auth)

8206 EXTREME TEMPERATURE STUDIES WITH DROPLETS OF MOLTEN REFRACTORY MATERIALS. Nelson, L. S. (Sandia Lab., Albuquerque, N. Mex.). Pure Appl. Chem., Suppl.; 565-74(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

Methods of studying molten specimens of submillimeter dimensions in free fall are described. The specimens are heated to melting by exposure to a flash lamp or Nd-glass laser. High-speed techniques are used to record data on the sample during fall and microanalytical techniques are used in study of the sample during and after quenching in liquid Ar. (J.R.D.)

8207 CARBIDE SINGLE CRYSTALS PRODUCED BY SOLID-STATE GRAIN GROWTH. Fleischer, L. R.; Tobin, J. M. (Westinghouse Astronuclear Lab., Pittsburgh). Pure Appl. Chem., Suppl.; 665-72(1969).

From 3rd International Symposium on High Temperature Technology, Pacific Grove, Calif. See CONF-670935.

Large crystals of transition metal monocarbides were grown as a result of two concurrent processes: formation of the carbides by reaction of the molten metals with carbon, and microstructural transformations in the growing carbides leading to discontinuous grain growth. Plastic strain of the carbide phase induced primary recrystallization, and secondary recrystallization of the primary structure resulted in high-quality, large single crystals. It is recognized that preferred orientation and texture may play an important role in the microstructural transformations, but this aspect has not yet been investigated. The single crystals of ZrC, VC, HfC, and NbC produced appeared to be randomly oriented. Questions concerning the strain and temperature dependences of recrystallization in the carbides and the kinetics of recrystallization are raised which can only be answered by further experimental work. (auth)

8208 URANIUM AND PLUTONIUM SYSTEMS WITH CARBON, OXYGEN, AND NITROGEN. PHASE DIAGRAMS AND METHODS OF PREPARATION. Akhachinskii, V. V.; Bashlykov, S. N. At. Energ. (USSR); 27: 524-32(Dec 1969). (In Russian).

Recent information available on the phase diagrams of the systems U–C, U–N, U–C–N, U–C–O, Pu–C, Pu–C–O and the methods of preparing compounds of these systems is briefly discussed. (auth)

Radiation Effects

Refer also to abstract 8183.

8209 (EURFNR–680) MELTING PHENOMENA IN UO_2 IRRADIATION SAMPLES. Geithoff, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Translation of report KFK-980. 28p. Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 51145.

8210 (GA–9042) EFFECTS OF FAST-NEUTRON IRRADIATION ON PYROLYTIC SILICON CARBIDE. Price, R. J. (Gulf General Atomic, Inc., San Diego, Calif.). 12 Nov 1968. Contract AT(04-3)-167. 10p. Dep. CFSTI.

Samples of pyrolytic polycrystalline β-silicon carbide were irradiated to 2.0 to 4.2 × 10^{21} nvt (E greater than 0.18 MeV) at temperatures between 460 and 1040°C. The samples showed an isotropic linear expansion that decreased with increasing irradiation temperature from 0.35% at 460°C to 0.05% at 1040°C. The lattice parameter changes were equal to the macroscopic dimensional changes within experimental accuracy. Irradiation caused a slight increase in x-ray line broadening that was attributable to the generation of internal strains. There was no significant change in Young's modulus or the modulus of rupture. (auth)

8211 (NUMEC–3524–67) DEVELOPMENT AND TESTING OF PuO_2–UO_2 FAST REACTOR FUELS. 16th Quarterly Report, January–March 1969. (Nuclear Materials and Equipment Corp., Leechburg, Pa. Plutonium Lab.). Aug 1969. Contract AT(30-1)-3524. 32p. Dep. CFSTI.

Subassembly X015 containing 11 NUMEC fuel capsules was removed from the ERB-II reactor after completing the scheduled irradiation exposure goal. Peak burnup of these 20% PuO_2-UO_2-316L clad rods is 57,000 MWd/te. Subassembly XO12 containing 19 C Series fuel capsules is continuing its irradiation toward a goal exposure of 100,000 MWd/te. Diametral changes in the A-

Series fuel rods (20 wt % PuO_2-UO_2-316L clad, 0.252 in. OD × 0.015 in. wall) irradiated to 33,000 MWd/te peak at 12 to 15 kW/ft in EBR-II ranged from 0.50 to 0.82% ΔD/D peak based on preliminary measurements prior to precision profilometry. The peak diametral increase for 6 rods containing 87 to 88% smeared density mixed oxide averaged 0.60% ΔD/D. The peak diametral increase for 4 rods containing 80 to 82% smeared density fuel also averaged 0.60% ΔD/D. Two rods containing 87.5% smeared density fuel fabricated with dished-end pellets averaged 0.68% ΔD/D. The lowest diametral swelling observed in this test series occurred in an 87% smeared density fuel rod in 0.015 in. wall thickness Hastelloy-X. This rod had a peak ΔD/D of 0.29%. Interim neutron radiography of 11 Series-B encapsulated 20 wt % PuO_2-UO_2 fuel rods after irradiation to 57,000 MWd/te peak has shown ten of the rods to be in good condition and one rod to have failed. The failed rod (B-11) operated at peak heat generation rates of 14.4 to 15.9 kW/ft. The affected zone was in the peak flux region and extended from 4 to 11½ in. above the bottom of the fuel column. Local diametral increases are estimated to be approximately 15% ΔD/D. The failed rod contained stoichiometric mixed oxide, fabricated from mechanically blended and master blend powders. Final pellet stoichiometry was obtained by a low temperature oxidizing heat treatment of originally hypostoichiometric pellets. The counterpart rod in the A-Series (A-11) exhibited normal diametral growth after exposure to 31,000 MWd/te peak at heat generation rates of 12.5 to 14.1 kW/ft. Pellet fabrication variability tests have been made using 20% PuO_2-UO_2 mixtures prepared by mechanically blending UO_2 with PuO_2 derived from oxidation of Pu metal. In processing PuO_2 derived from the oxidation of metal, a difference in milling characteristics had been noted between PuO_2 made by air-steam oxidation of metal and PuO_2 made by argon-oxygen-steam oxidation. It was found that the argon-oxygen-steam oxidized material could be reduced to a particle size of less than 1.2 microns more readily than the air-oxidized material, as required to meet basic sinterability requirements for PuO_2 powder. The oxalate route PuO_2 and 93% enriched UO_2 have been received and analyzed. The PuO_2 has been recalcined and dry ballmilled to meet assay and particle size requirements. Initial sintering trials on small batches of 25 wt % PuO_2-UO_2 indicate satisfactory raw material performance from a microhomogeneity and fabrication point of view. Unusually low O/M ratios of 1.94 to 1.95 were obtained during sintering of the test pellets, as compared with 1.96 to 1.98 during previous runs. This result was attributed to a recently changed gas flow pattern and low moisture content in the sintering furnace. Rod closure weld development work has commenced and early results indicate that a satisfactory procedure for the required 100% minimum penetration has been achieved. Delivery dates for cladding, end cap rod stock and other hardware items which are being purchased by PNL from commercial vendors for joint use by PNL and NUMEC, are expected to be scheduled during April and May of 1969. (auth)

8212 RADIATION-INDUCED PROPERTY CHANGES IN CRISTOBALITE (SiO_2). Schenk, M. (Zentralinstitut fuer Festkoerperphysik und Werkstofforschung, Dresden). Phys. Status Solidi; 36: K101-4(1 Dec 1969).

The effects of reactor irradiations up to 3×10^{18} fast neutrons/cm^2 on the lattice parameters, transformation heats, and transformation temperature (230°C) of Cristobalite were determined. A radioinduced phase transformation of the tetragonal form into the high-temperature cubic form took place at ~1.2×10^{18} n/cm^2. The transformation heat was cut into half at 3.5×10^{17} n/cm^2, and the shift in the transformation temperature was −47°C. Annealing effects were also studied. (D.L.C.)

Plastics and Other Materials

Refer also to abstract 8216.

8213 (AECL-3327) PLASTIC IMPREGNATION OF FIBROUS MATERIALS: AN ANALYSIS OF THE ECONOMICS OF VARIOUS CURING METHODS. Rotkirch, Eric. Translated for Atomic Energy of Canada Ltd., Ottawa, and edited by A. G. Davies, from Pap. Puu, No. 4, 1968. 64p. Dep. CFSTI (U. S. Sales Only).

An attempt was made to estimate the costs for producing plastic impregnated wood and fibrous materials. The comparative economic merits of various monomer curing methods are discussed, and calculated figures for the radiation as well as for the catalytic method, are given: It was found that the dominating cost in manufacturing wood-plastic combinates (WPC) or polymerimpregnated plywood, fiber and chipboard etc., is the cost of chemicals. The curing costs are of the order of 10% of the total processing costs. A closer study however indicated, that radiation curing has some merits as compared with the catalytic method. Evidently cheaper impregnation material (monomer mixtures) can be used. For surface impregnation and curing, the irradiation method seems to allow higher running speed than the catalytic reaction. The high capital costs of irradiation plants are a disadvantage. This suggests use of catalyst for small production and radiation curing when larger production is in question. The large cost portion occupied by impregnation chemicals led to the conclusion that impregnation of surface layers in various board materials and coating solid wood with polymer impregnated veneer sheets will be the most economic proposals today. (auth)

8214 (BNWL-CC-774) FRACTURE TOUGHNESS OF GRAPHITE DOUBLE CANTILEVERED BEAM SPECIMENS. Slind, L. O. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1969]. Contract AT(45-1)-1830. 20p. Dep. CFSTI.

A double cantilever beam specimen was calibrated and found useful in determining the plane strain fracture toughness of SGBF nuclear graphite, G_{Ic}, the plane strain energy release rate, and K_{Ic}, the plane strain stress intensity factor, were determined to be 1.18 in. lb/in.^{2} and 1386 $\sqrt{\text{in.}}$ lb/in.^{2}, respectively at room temperature. These values are for with-the-grain fractures only. (auth)

8215 (HN-20-1018) POLYURETHANE FOAM TUNNEL LINER BACKPACKING FOR PROJECT PILEDRIVER, OPERATION FLINTLOCK. Final Report. (Holmes and Narver, Inc., Las Vegas, Nev. On-Continent Test Div.). Jan 1967. 81p. Dep. CFSTI.

The development and testing of rigid polyurethane foam for use as a shock-absorbent back packing material placed around tunnel liners for Project Piledriver, Operation Flintlock are described. Prior to actual placing of foam at the required locations, experimental work from which foam formulation and optimized placement techniques were developed were conducted both in the manufacturer's plant and in the underground tunnel. The poured-in-place method using batch injection type equipment was used in placing nearly 600 cubic yards of foam averaging 7.5 lb/ft^3 in density. Foam was placed in 6 annular spaces created by the excavation of the tunnel and 6 circular liners, each 18 feet in length. The thickness of annulars was approximately 4 feet. Emplaced foam was tested in accordance with specified procedures for conformance to required physical properties. Tests included were static and confined compression tests, and dynamic unconfined compression tests. Results of these tests showed the emplaced foam to be substantially in agreement with the specification requirements in regard to yield stress, yield strain, and variation of stress within the specified strain range. Field observations indicated the method and equipment used for foam placement to be satisfactory and the chemical fumes evolved during placing operations to be below the threshold limit value. (auth)

8216 CONFERENCE ON ELECTRICAL INSULATION AND DIELECTRIC PHENOMENA. 1967 Annual Report, Pocono Manor, Pennsylvania, September 18–20, 1967. Publication 1578. Washington, D. C.; National Academy of Sciences (1968). 211p. $10.00. (CONF-670957).

Twenty-nine papers were presented at the conference. An abstract was prepared for one paper. The other papers are concerned with unirradiated dielectric materials and electric properties of unirradiated materials. (J.R.D.)

For an abstract of the individual paper see: 8217.

8217 COMPARISON BETWEEN ELECTRICAL CONDUCTION IN POLYETHYLENE UNDER GAMMA IRRADIATION AND WITHOUT IRRADIATION. Yahagi, Kichinosuke; Shinohara, Kenichi (Waseda Univ., Tokyo). pp 44-8 of Conference on Electrical Insulation and Dielectric Phenomena. Washington, D. C.; National Academy of Sciences (1968).

From Conference on Electrical Insulation and Dielectric Phenomena, Pocono Manor, Pa. See CONF-670957.

Phenomena of electric conductivity in polyethylene as revealed in voltage-current curves, temperature dependence data, and data on conductivity in air, vacuum, and silicone oil are examined. The data included are presented graphically. (J.R.D.)

8218 IMPROVEMENTS IN AND RELATING TO CALCIUM HYDROXIDE. Boler, Robert (to Nuclear Power Group Ltd.). British Patent 1,173,676. 10 Dec 1969. Filed 1 Sep 1967.

A process is described for the treatment of calcium hydroxide intended for use in radiation shields; such a material is particularly suitable for high temperature and high radiation flux applications. The treatment reduces the hygroscopic action of the hydroxide and minimises its susceptibility to shrinkage at elevated temperatures: it comprises sintering by means of steam at above atmospheric pressure and at 400°C or above. A radiation shield is also described comprising closed metallic tubular members containing the treated hydroxide. (UK)

PHYSICS (GENERAL)

Astrophysics and Cosmology

Cosmic Ray Exposure Ages

Refer also to abstract 8366.

8219 IODINE, URANIUM, AND TELLURIUM IN METEORITES. Clark, Robert Stephen. Fayetteville, Ark.; Univ. of Arkansas (1969). 59p.

Thesis.

The abundances of iodine, uranium, and tellurium were determined in fifteen achondrites, five chondrites (two with light-dark structure), and three mesosiderites by neutron activation analysis. In thirty analyses on achondrites the following range of abundances were found: I, 14 ppb to 1 ppm; U, 2 to 210 ppb and Te, ≤0.03 to 3 ppm. These elements vary within a given class of achondrites and the individual achondrites show a higher degree of heterogeneity than the chondrites. Uranium contents range higher and tellurium contents lower in achondrites than in chondrites. Weaker correlation between iodine and tellurium is observed in achondrites than in chondrites. (Diss. Abstr.)

8220 COSMIC METALLURGY. Reed, S. J. B. Sci. J.: 5A: 63-74(Dec 1967).

The use of modern metallurgical ideas and techniques in examining meteorites is discussed. By these means the meteoritic metal can be made to serve as a kind of remote thermometer and pressure gage, monitoring events that took place early in the evolution of the solar system. (W.D.M.)

Stars

8221 (AD-693574) THEORETICAL INVESTIGATION INTO RADIATIVE TRANSFER AND HYDRODYNAMIC MOTIONS IN SPHERICAL STELLAR ATMOSPHERES, AND INTO STEADY SHOCK WAVES IN HYDROGEN. Final Report, March 1, 1964–April 30, 1969. Whitney, Charles A. (Harvard Coll. Observatory, Cambridge, Mass.). Jun 1969. Contract AF19(628)-3877. 16p. (AFCRL-69-272). CFSTI.

Work under this contract considered a variety of subjects related to the influence of gas-dynamic motions on the structure of stellar atmospheres. This report summarizes the topics and provides a guide to the bibliography dividing the papers into the following categories: (a) mathematical techniques, (b) theory of line transfer, (c) gas dynamics of stellar media, and (d) the structure of the solar chromosphere. This work provides the theoretical basis for the systematic development of an increasingly important branch of astrophysics—the gas dynamics of stellar media. (auth) (USGRDR)

8222 PRIMORDIAL HELIUM ABUNDANCE AS DETERMINED FROM THE BINARY STAR SYSTEM μ-CASSIOPEIAE. Hegyi, Dennis Jerome. Princeton, N. J.; Princeton Univ. (1969). 113p.

Thesis.

μ-Cassiopeiae is an old binary star system whose chemical composition is characteristic of the early stages of formation of the Galaxy. One measurement of the distance between the two stars combined with existing orbital data makes possible a determination of the masses of the stars, and hence, using the theory of stellar interiors, their helium abundance. An image analyzer was constructed which scans the stellar image with a slotted wheel. The light passing through the wheel is detected with a photomultiplier and recorded in a time base 400 channel analyzer. The light distribution obtained from 20,000 scans of the image is coherently superposed in the analyzer and later read out for analysis. This coherent superposition technique reduces atmospheric noise. Data were taken at Lick Observatory on μ-Cassiopeiae, and also on a nearby calibration star to determine the instrumental response. Results of the data analysis yielded a helium abundance of .03 ± .08 (standard deviation of the mean). (Diss. Abstr.)

8223 A STUDY OF V566 OPHIUCHI. Bookmyer, Beverly B. (Univ. of Arizona, Tucson. Kitt Peak National Observatory, Tucson, Ariz.). Astron. J.: 74: 1197-1205(Dec 1969).

Photoelectric observations of V566 Ophiuchi, a W UMa-type eclipsing variable system, were obtained with B and V filters on five nights in 1966. The resultant light curves are in agreement with those observed by Binnendijk in 1957 and confirm the fact that the system undergoes complete eclipses with secondary minimum occurring during the total eclipse. Three analyses of the photometric observations are presented; these yield magnitude differences between the components of 2.2 m, 2.0 m, and 1.7 m in yellow light. These values are in agreement with the value 1.9 m derived by Abt from his spectrographic observations in blue light. (auth)

8224 WAVELENGTH DEPENDENCE OF POLARIZATION. XVIII. INTERSTELLAR POLARIZATION AND COMPOSITE INTERSTELLAR PARTICLES. Coyne, G. V. (Univ. of Arizona, Tucson); Wickramasinghe, N. C. Astron. J.: 74: 1179-90(Dec 1969).

Further observations in a continuing survey of the polarization of early-type stars in the galactic plane in the wavelength range 0.3 to 0.9 μ are presented. Twenty-five percent of the stars in this survey show a rotation of the plane of polarization with wavelength. The observations are discussed in terms of a composite interstellar-grain model with a graphite core and dielectric mantle. Approximate solutions for the wavelength dependence of the polarization produced by an idealized model, consisting of a thin graphite disk with a radius of 0.05 μ imbedded in a dielectric oblate spheroid with a semimajor axis, a = 0.3 μ, and a semiminor axis, af, with $0.7 \leq f \leq 0.9$, are given. The best fit to the average interstellar polarization is given by values of $0.7 \leq f \leq 0.8$. Larger values of f may explain the simultaneous occurrence in some stars of large visual-to-ultraviolet polarization ratios and small visual-to-infrared polarization ratios. (auth)

8225 PHOTOELECTRIC OBSERVATIONS OF DO CAS DURING 1967. Gleim, James K. (Univ. of Florida, Gainesville); Winkler, Louis. Astron. J.: 74: 1191-6(Dec 1969).

The β Lyrae eclipsing binary, DO Cas, was reobserved photoelectrically in blue and yellow light. Improved light curves were obtained and a consistent orbital solution obtained from them. Although the system appears to be more reasonable than was previously thought, a number of unusual and interesting features remain. The fainter component does not exhibit a spectrum, but it produces an oblateness of 0.115 in the component with the spectrum. A ratio of the sizes of the bright to faint component appears to be exceptionally large with a value of 2.22. The ratio of the duration of secondary totality to the duration of primary totality is approximately 3. Secondary minimum is shifted relative to phase 0.50 and is tilted. (auth)

8226 PHOTOMETRIC STANDARDS FOR THE SOUTHERN HEMISPHERE. Bok, Bart J.; Bok, Priscilla F. (Univ. of Arizona, Tucson. Cerro Tololo Inter-American Observatory, La Serena, Chile). Astron. J.: 74: 1125-30(Dec 1969).

About ten years ago, the authors published a paper (Bok and Bok 1960) with several standard sequences for southern hemisphere work. Additional photoelectric measurements have been made since then, first from Australia (Mount Stromlo and Siding Spring Observatories), and more recently from Chile (Cerro Tololo Inter-American Observatory). Since so much effort is now being expended on research of the Southern Milky Way and of the Magellanic Clouds, it may be helpful to bring some of the results together in one place. (auth)

8227 A (uvby) STUDY OF RR LYRAE FIELD STARS. Epstein, I. (Columbia Univ., New York. Kitt Peak National Observatory, Tucson, Ariz. Cerro Tololo Inter-American Observatory, La Serena, Chile). Astron. J.: 74: 1131-51(Dec 1969).

Observations at minimum light in the four-color system of Strömgren and Perry of 38 variables, mostly of type RRa, are used to find interstellar absorption corrections in the four-color system. The intrinsic metal index $(m_1)_0$ is found to correlate well with Preston's ΔS and with Sturch's δ (U−B). Correlations of $(m_1)_0$ with kinematic properties of the variables indicate a separation of the RRa population into a relatively high metal-content group having a disk galactic distribution and into a low metal-content group having a spherical distribution. The two groups are largely overlapping in the indices $(b-y)_0$ and $(c_1)_0$. The low metal-content group variables show a period−luminosity relation in the sense of increasing luminosity with increasing period. (auth)

8228 UBV PHOTOMETRY AND SPECTRAL TYPES IN NGC 6611. Hiltner, W. A.; Morgan, W. W. (Univ. of Chicago, Williams Bay, Wis.). Astron. J.: 74: 1152(Dec 1969).

UBV photometry and MK types are given for 15 of the brightest members of NGC 6611. A comparison with results of Walker shows good agreement in magnitudes but systematic differences in B−V and U−B. (auth)

8229 ROTATIONAL VELOCITIES IN NGC 2516. Abt, Helmut A. (Kitt Peak National Observatory, Tucson, Ariz. Cerro Tololo Inter-American Observatory, La Serena, Chile); Clements, Arthur E.; Doose, Lyn R.; Harris, Daniel H. Astron. J.; 74: 1153-4(Dec 1969).

The mean rotational velocities in the open cluster NGC 2516 are found to be similar to the unique mean rotational velocities in the Pleiades after eliminating the many Ap stars in the former cluster. This result supports the suggestion by Eggen that the two clusters have a common origin. (auth)

8230 SOME PROPERTIES OF K-GIANT FIELD STARS. Helfer, H. L. (Univ. of Rochester, N. Y.). Astron. J.; 74: 1155-67(Dec 1969).

Photometrically determined temperatures and metal abundances are given for approximately 175 early K giants belonging to the disk population. A class of metal-rich stars exist. Approximately ⅓ of the stars have greater than solar metal abundance, while less than 5% have metal deficiencies of a factor of three or more compared to the Sun. The high-velocity stars exhibit no preferred metal abundance in the range $+0.2 \geq [Fe/H] \geq -0.8$. Using K-line absolute magnitudes, space velocities and an effective mass index are also calculated for each star. The mass index is shown to be an observationally useful quantity. A class of massive metal-deficient stars definitely exists; it is also probable that some low-mass ($\leq 1M_{\odot}$) K giants exist. The stars for which $[Fe/H] \geq -0.1$ possess distinctly different kinematic properties than the stars for which $[Fe/H] \leq -0.2$. The simplest interpretation of the data is that two different components of the interstellar medium presently exist, one of normal metal content, the other of metal deficiency. The metal-deficient component does not travel around the galactic center in circular orbits. There is no simple way in which the observed range of values of [Fe/H] can be interpreted as being equivalent to a crude time scale. A comparison of trigonometric parallaxes and K-line magnitudes is made. A correction to the K-line absolute magnitudes, depending upon metal abundance (applicable only to early K giants for which $[Fe/H] > -1$), appears to be in order; the suggested correction is given. (auth)

8231 A PHOTOELECTRIC Hβ DISTANCE MODULUS OF THE OPEN CLUSTER NGC 6871. Cohen, Howard L. (Univ. of Florida, Gainesville). Astron. J.; 74: 1168-70(Dec 1969).

Photoelectric Hβ observations are reported for ten bright OB stars (including the eclipsing binaries V448 Cyg and V453 Cyg) in the field of NGC 6871. The derived distance modulus of NGC 6871 (11.4 mag) confirms values in the literature derived from wideband photometry. Both eclipsing binaries are placed at the same distance as the cluster (1.9 kpc). The Hβ observations, transformed into values of W_{Hy}, agree with published spectroscopic values of W_{Hy} and disagree with published photoelectric W_{Hy} values. Hence, the published H_y modulus (9.8 mag) appears to be too small. (auth)

8232 PHOTOMETRIC OBSERVATIONS OF THE STAR CLUSTER IC 166. Burkhead, Martin S. (Indian Univ., Bloomington). Astron. J.; 74: 1171-6(Dec 1969).

Photoelectric and photographic photometry are presented for the cluster IC 166. The cluster exhibits the upper end of an evolved main sequence at (B−V) = 1.15, mv = 17.0; a Hertzsprung gap from (B−V) = 1.2 to 1.6, mv = 17.0; and a well-defined giant region from (B−V) = 1.6 to 1.8, mv = 17.0 to 16.5. The color excess is poorly determined, but is assumed to be $E_{(B-V)} = 0.80$; the distance modulus is m−M = 12.6. IC 166 appears to be an intermediate-age cluster similar in age to NGC 7789 and NGC 752. (auth)

8233 ATMOSPHERIC PHENOMENA IN CLASSICAL CEPHEIDS. Hillendahl, Richard Warren. Berkeley, Calif.; Univ. of California (1968). 128p.

Thesis.

Existing methods of interpreting the observational data from classical cepheids are examined and found to suppress the information content of the observations because of inapplicable assumptions or physical models, smoothing of the observations, and observations too widely separated in time during the pulsation cycle. Revised methods of interpreting the observations are then devised. Dynamic model atmospheres are constructed based on temperature profiles which result primarily from hydrodynamic motion of the gas, and in which radiative transfer is secondary. These models lead to unusual atmospheric profiles in which an extended halo surrounds a photosphere having very steep gradients, and to the identification of hydrodynamic phenomena in the atmosphere. The observed phenomena in cepheids are then interpreted in terms of the radiating properties of shock and rarefaction waves. A new fundamental process is identified which occurs near the outer limits of the atmosphere. A shock reaching the edge of the star creates a rarefaction wave which in turn causes another outward shock. This sequence of events repeats until interrupted by some other process. The process appears to be a possible contributor to the observed behavior of a wide range of variable stars. Radiation-hydrodynamics computations are then used to verify the interpretation of the observational results and to study the cause and effect relationships between the various phenomena. The sequence of phenomena in cepheid atmospheres is found to be more complicated than originally envisioned, and involves multiple shocks and rarefaction waves. The results obtained compare favorably with observation and appear to offer explanations for a number of previously unexplained phenomena. (Diss. Abstr.)

8234 MEAN ABSOLUTE MAGNITUDES OF CARBON STARS. Alksne, Z. K. Latv. PSR Zinat. Akad. Vestis; No. 9, 52-60(1969). (In Russian).

It was found that the results of calculation of mean visual absolute magnitudes for several types of carbon stars obtained by both $\pi\mu_v$ and $\pi\mu_v$ parallax methods agreed well and did not depend (1) on the choice of fundamental system used for proper motions, (2) on the choice of constants, (3) on the choice of components of Solar motion or (4) on brightness of stars used. It was found that a correlation existed between the mean absolute magnitudes of semi-regular variable carbon stars and their amplitudes or periods of brightness variation. The dependence of the absolute magnitude on spectral C subclasses was investigated. The estimates of absolute photographic and infrared magnitudes are given. (auth)

8235 EVOLUTIONARY EFFECTS IN THE ROTATION OF SUPERGIANTS. Rosendhal, Jeffrey David. New Haven; Yale Univ. (1968). 188p.

Thesis.

A statistical investigation was made of rotation, macroturbulence, and microturbulence in Ia and Iab supergiants. For purposes of this study, coudé spectrograms of 64 stars in the spectral range 09.5 to A5 were taken using the 84-inch reflector of the Kitt Peak National Observatory. The reductions were performed by calculating theoretical line profiles and by means of standard curve of growth techniques. The principal results are: (1) There is no strong evidence for the existence of large-scale differential motions in supergiant atmospheres in the spectral range B0 to A0. (2) At all spectral types in the range B0 to A5, both rotation and macroturbulence contribute to the observed line broadening. (3) In spite of the fact that the stars observed seem to be losing mass, there is no strong evidence for significant angular momentum loss. (4) Time dependent phenomena are probably important in supergiant atmospheres. In particular, among the early A stars, there is evidence for changes in the small-scale velocity fields. (5) In the A supergiants, the microturbulence increases with height in the atmosphere. (6) In the stars of luminosity class Ia, the microturbulence increases from middle B through late A, reaches its maximum somewhere in the spectral range F2 to F5, and then decreases suddenly at about spectral type G0 to G2. The behavior appears to be similar in the spectral range A to M in the less-luminous supergiants and bright giants. (Diss. Abstr.)

8236 PERIOD CHANGES OF RR LYRAE VARIABLES IN THE GLOBULAR CLUSTER M5. Coutts, Christine Mary. Toronto; Univ. of Toronto (1967).

Thesis.

The purpose of the present investigation was to study period changes of the RR Lyrae variables in the globular cluster M5. In this thesis, the method of investigating period changes by means of a phase-shift diagram is described. The work by other investigators in the field of period changes of RR Lyrae variables in globular clusters is discussed. On 167 plates taken at the David Dunlap Observatory, 66 RR Lyrae stars were measured, mainly with an iris photometer. In addition, 63 of these stars were measured on 33 plates (64 exposures) taken by Shapley in 1917 with the 60-inch telescope on Mt. Wilson. No measures from these plates have ever been published. Apparent photographic magnitudes were also estimated for two stars in this cluster of the class of W Virginis. The RR Lyrae measurements, supplemented by some published material by Bailey (1917) and Oosterhoff (1941) were used to investigate the period changes of the RR Lyrae variables in M5. It was found that 18 stars had constant periods, 13 had decreasing periods, and 20 increasing. The other 15 were too irregular for the nature of the period change to be understood. The median rate of change of period for those increasing is 0.015 days per million years; the median rate for those decreasing is about 0.012 days per million years. It is suggested that when changes in period take place, they occur abruptly rather than gradually. It is proposed that these period changes are evolutionary. An attempt was made to compare these stars with models of horizontal branch stars described by Faulkner and Iben (1966). (TSS)(Diss. Abstr.)

8237 DYNAMIC EVOLUTION OF RICH GALACTIC CLUSTERS. Prata, Stephen William. Berkeley, Calif.; Univ. of California (1968). 141p.

Thesis.

A model procedure is developed to represent a rich galactic cluster and known processes affecting its evolution. The representation is intended to be as complete and as realistic as is currently feasible. The procedure is used to make evolutionary studies for the old galactic cluster M67. The M67 studies are then used as a starting point for a more general study of evolutionary effects. (TSS)(Diss. Abstr.)

8238 VARIABLE POLARIZATION IN LATE-TYPE STARS. Dyck II, Herman Melvin. Bloomington, Ind.; Indiana Univ. (1969). 120p.

Thesis.

Polarimetric observations in two colors were obtained for 21 late-type stars of various spectral types in order to delineate the phenomenon of variable stellar polarization. The data were collected using two photoelectric polarimeters constructed during the project. A general technique was developed for the removal of instrumental and atmospheric effects from the raw polarization measurements. In addition, it is shown that colors and magnitudes can be derived quite simply from the polarization measurements. (TSS)(Diss. Abstr.)

8239 A DIFFERENTIAL CURVE OF GROWTH ANALYSIS OF THE SPECTRUM OF THE STAR THETA URSAE MAJORIS. Mangold, Edward Covert. Stillwater, Okla.; Oklahoma State Univ. (1968). 203p.

Thesis.

The intensities of absorption lines appearing in the spectrum of the star θ Ursae Majoris were analyzed by a differential curve of growth technique to obtain information concerning the properties of the stellar atmosphere. Equivalent widths were measured for 444 lines. (TTT)(Diss. Abstr.)

8240 STELLAR ASTRONOMY. VOLUME 1. Proceedings of the Summer Institute for Observational Astronomy, Held at Stony Brook, N. Y., Summer 1967. Chiu, Hong-yee; Warasila, Robert L.; Remo, John L. (eds.). New York; Gordon and Breach Science Publishers Inc. (1969). 385p. $29.50. (CONF-670668-(Vol.1)).

The included lectures were presented at the State University of New York at Stony Brook from June 21 to July 8, 1967. The material covers a broad range of topics in observational stellar astronomy, including observation techniques, classification schemes of stellar spectra, stellar atmospheres and line formation, and stellar rotation. (W.D.M.)

8241 INTRODUCTION TO STELLAR STATISTICS. Kurth, Rudolf. International Series of Monographs in Natural Philosophy. Volume 10. New York; Pergamon Press (1967). 184p.

The emphasis is more on astronomical than statistical aspects and on methods than on results. An heuristic approach is adopted and very simple qualitative considerations precede mathematical deductions. Only the first elements of calculus and analytical geometry are required to follow the arguments. (W.D.M.)

8242 STELLAR ASTRONOMY. VOLUME 2. Proceedings of the Summer Institute for Observational Astronomy, Held at Stony Brook, N. Y., Summer 1967. Chiu, Hong-yee; Warasila, Robert L.; Remo, John L. (eds.). New York; Gordon and Breach Science Publishers Inc. (1969). 365p. $29.50. (CONF-670668-(Vol.2)).

The included lectures were presented at the State University of New York at Stony Brook from June 21 to July 8, 1967. The material covers a broad range of topics in observational stellar astronomy, including stellar angular momentum and binaries, white dwarfs and magnetic stars, theoretical models, ultraviolet and infrared astronomy, and automation in observations. (W.D.M.)

8243 EMITTED SPECTRUM OF A PROTOSTAR. Larson, Richard B. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Mon. Notic. Roy. Astron. Soc.; 145: 297-308(1969).

The spectral energy distribution emitted by a collapsing protostar was calculated on the basis of some simple approximations for the radiative transfer in the extended spherical "atmosphere" of the protostar. Results for the evolution in spectral appearance are presented for several of the collapsing protostar calculations described in a previous paper (Larson 1969). Comparison is made with some observations of infrared objects in Orion and with recent infrared observations of T Tauri stars. (auth)

8244 NUMERICAL CALCULATIONS OF THE DYNAMICS OF A COLLAPSING PROTOSTAR. Larson, Richard B. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Mon. Notic. Roy. Astron. Soc.; 145: 271-95(1969).

Numerical calculations of the dynamics of a spherically symmetric collapsing protostar of one solar mass have been made for various initial conditions. Calculations have also been made for masses of $2M_\odot$ and $5M_\odot$. In all cases the collapse is found to be extremely nonhomologous and is such that a very small part of the cloud's mass at the center reaches stellar densities and stops collapsing before most of the cloud has had time to collapse very far. The stellar core thus formed subsequently grows in mass as material falls into it, finally becoming an ordinary star when all the protostellar material has been accreted. During most of this time the stellar core is completely obscured by the dust in the infalling cloud, the absorbed radiation reappearing in the infrared as thermal emission from the dust grains. The resulting star is almost a conventional Hayashi pre-main sequence model, but it appears rather low on the Hayashi track. For masses much greater than about $2M_\odot$ the convective Hayashi phase does not exist at all. It appears that certain properties of T Tauri stars may find explanation in the results of the present calculations. In an appendix to the paper it is shown that limiting forms may be derived for the density and velocity distributions near the center of an isothermally collapsing sphere. This may be shown to be possible also for a sphere with a polytropic equation of state. Numerical results are presented for the limiting solution in the isothermal case. (auth)

8245 LOW-LUMINOSITY STARS. Proceedings of the Symposium Held March 28-30, 1968, Charlottesville, Virginia. Kumar, Shiv S. New York, Gordon and Breach Science Publishers, 1969. 556p. (CONF-680317).

The first section gives the latest spectroscopic, photometric, and astrometric data on all kinds of intrinsically faint stars. Section II is concerned with flare stars, and the emphasis is on observational data. Section III is mostly theoretical and gives a summary of the latest results on the equation of state for low-mass stars. Detailed calculations on the structure and evolution of low-mass stars are also presented. Papers in Section IV are mostly theoretical and deal mainly with white dwarfs. Section V deals with theoretical calculations on the early dynamical contraction of stars. The final section is concerned with the atmospheric structure of cool stars and gives a fairly detailed account of the present knowledge of the atmospheric structure of cool dwarfs. (W.D.M.)

8246 NONRADIAL PULSATION OF GENERAL-RELATIVISTIC STELLAR MODELS. IV. THE WEAK-FIELD LIMIT. Thorne, Kip S. (California Inst. of Tech., Pasadena). Astrophys. J.; 158: 997-1019(Dec 1969).

In previous papers of this series techniques were developed for calculating the properties of the nonradial, quasi-normal pulsations of fully relativistic stellar models. In this paper those techniques are reexamined in the weak-field, nearly Newtonian limit, and are found to predict an emission of gravitational radiation at a rate which agrees with the standard weak-field approximation to general relativity. The present analysis also exhibits explicitly the radiation-reaction forces inside the star and shows that they sap pulsation energy from the star at the same rate as the waves carry it off. Following a train of ideas due to Burke, the analysis is generalized to any weak-field, slow-motion system; and the relationship of the analysis to the post-Newtonian expansion schemes of Chandrasekhar and Fock is discussed. It is shown that the dominant radiation-reaction forces associated with each changing multipole moment can be incorporated into Newtonian theory by a simple change in the boundary condition for the Newtonian potential at radial infinity. (auth)

8247 UNIMPORTANCE OF BOUND ELECTRONS IN INFLUENCING NUCLEAR-REACTION RATES. Iben, Icko Jr. (Massachusetts Inst. of Tech., Cambridge). Astrophys. J.; 158: 1033-5(Dec 1969).

Screening by bound electrons has a negligible effect on thermonuclear-reaction rates in stellar interiors. (auth)

8248 ADVANCED PHASES OF EVOLUTION IN MASSIVE RED SUPERGIANTS. Stothers, Richard; Chin, Chao-wen (Goddard Inst. for Space Studies, New York). Astrophys. J.; 158: 1039-57(Dec 1969).

Very general models have been constructed for the advanced phases of evolution in massive stars of 15, 30, and 60 $M_\odot$. Independent of the surface condition and the specification of the central energy source, the models may be specified by the two quantities E and T_c. Introduction of the physical boundary conditions shows that the models represent evolutionary sequences of convective red supergiants. The phases of carbon, neon, and oxygen burning in the

stellar core are considered, with and without the inclusion of the hypothetical electron–neutrino processes. Two starting core compositions are chosen: (1) pure carbon and (2) pure oxygen. Limitations on the possible structure and lifetime up to the presupernova stage are determined. During core carbon burning in the star of 15 $M_\odot$, the core mass increases slightly, while above ~20 $M_\odot$ and during the later phases of 15 $M_\odot$, the core evolves with monotonically shrinking mass due to the deepening convective envelope. Products of the burning of hydrogen, helium, and carbon are mixed to the surface through the hydrogen-burning shell at the base of the envelope. Three tests of the hypothesis of electron-neutrino interaction have been made by comparing the theoretical results with the relevant observational data on the statistics of M supergiants, N and S stars, and yellow supergiants. The agreement between the results of all three tests points strongly toward the existence of the postulated interaction. (auth)

8249 INFLUENCE OF METAL CONTENT OF THE EVOLUTION OF STARS OF FIVE SOLAR MASSES. Schlesinger, Barry M. (Univ. of Chicago). Astrophys. J.; 158: 1059-74(Dec 1969).

Evolutionary tracks have been computed for stars of 5 $M_\odot$ with two choices of chemical composition: X = 0.67, Z = 0.03, and X = 0.64928, Z = 0.06. The tracks extend from the main sequence through the entire evolution to the blue in the H–R diagram during core helium burning. The H/He ratio is the same for both compositions. Physical properties of the two stars are compared over the evolutionary tracks. The star richer in metals is redder at the giant tip, but both giant branches extend blueward to the same value of log T_e: 3.678. Comparison of these results with the work of Hofmeister indicates that the major differences between her two tracks result from the difference in helium content. From a study of clusters in the Galaxy and in the Magellanic Clouds in the light of the new theoretical results, it is clear that the composition of at least parts of the Small Cloud is different from that of the Galaxy. Definite conclusions cannot be drawn regarding the composition of the Large Cloud. (auth)

8250 HYDROMAGNETIC OSCILLATIONS OF A DIFFERENTIALLY ROTATING SPHERICAL SHELL. Trehan, S. K.; Nakagawa, Y. (National Center for Atmospheric Research, Boulder, Colo.). Astrophys. J.; 158: 1075-80(Dec 1969).

The axisymmetric hydromagnetic oscillations of an incompressible inviscid fluid of infinite electrical conductivity in a differentially rotating spherical shell are considered when the prevailing magnetic and velocity fields are purely toroidal. It is shown that stable oscillations result with the observed form of surface differential rotation of the Sun and with the assumption that the core rotates with a constant angular velocity. The effect of differential rotation is shown to increase the period of oscillations. (auth)

8251 SPECTRAL CLASSIFICATION OF A-TYPE SPECTROSCOPIC BINARIES. Abt, Helmut A. (Kitt Peak National Observatory, Tucson, Ariz.); Bidelman, William P. Astrophys. J.; 158: 1091-8(Dec 1969).

MK spectral types were determined or are quoted for ninety-eight of 101 known spectroscopic binaries with primaries in the range A2–F3. Half of these stars are metallic-line (Am) stars; most of the remainder are outside the domain (approximately A4–F1, IV, V) of the Am stars. The remaining nine normal stars in the domain have periods of either less than 2.5 or more than about 100 days. It is concluded that all stars in the range A4–F1, IV, V that are primaries of binaries with periods of approximately 2.5 to 100 days have metallic-line spectra. (auth)

8252 NEW SUBDWARFS. II. RADIAL VELOCITIES, PHOTOMETRY, AND PRELIMINARY SPACE MOTIONS FOR 112 STARS WITH LARGE PROPER MOTION. Sandage, Allan (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena. Australian National Univ., Canberra). Astrophys. J.; 158: 1115-36(Dec 1969).

Radial velocities were measured for 112 stars of large proper motion selected from an unpublished photometric catalog which contains 300 new subdwarf candidates. The accuracy of the radial velocities is generally better than ±2 km sec^{-1}. Nine possible velocity variables were found, four of which are almost certain cases. Two particularly interesting variables (G9–16, G26–9) probably have blue subluminous companions which are brighter than white dwarfs but considerably fainter than main-sequence stars. Space motions for all stars are shown in a Bottlinger diagram. The asymmetrical-drift velocity and the dispersions in U and W increase systematically with decreasing metal abundance for the entire range of ultraviolet excess values from δ = 0.00 to δ = 0.31 mag. The results are interpreted in terms of a chemical gradient perpendicular to the galactic plane. Many globular-clusterlike subgiants are present in the material. Candidates are listed to aid future spectroscopic studies. The existence of subdwarfs possessing high angular momentum which lead the Sun in its galactic rotational velocity seems to be established. There may be a systematic variation of metal abundance with increasingly positive V velocity, but more subdwarfs of this type are needed to establish the correlation. Candidates can be found in proper-motion catalogs from among stars whose proper-motion angles are directed away from the high-velocity antapex. A procedure is given to correct observed ultraviolet excess values for stars with the same metal abundance but of different colors for the effect of the guillotine. (auth)

8253 ON THE uvby PHOTOMETRIC SYSTEM. Matsushima, Satoshi (Pennsylvania State Univ., University Park). Astrophys. J.; 158: 1137-49(Dec 1969).

A model-atmosphere analysis was carried out for uvby photometric data for a large sample of A- and early F-type main-sequence stars. The normalization constants for the theoretical color indices in the four-color system were determined on the basis of photoelectric scanner observations of twenty A-type stars. Correction factors for absorption lines derived from various methods were found to be in good agreement, and mutually consistent values for the effective temperatures were predicted by different color indices. The internal agreement between the resulting scale of effective temperature and scales previously derived by three other investigators on the basis of the same models but different observational data was found to be within a few percent, which appears to be about the best that can be expected at the present stage. (auth)

8254 THEORETICAL CONTINUOUS AND LINE SPECTRA OF STARS IN A CLOSE BINARY SYSTEM. Buerger, Paul (Ohio State Univ., Columbus. Ohio Wesleyan Univ., Delaware). Astrophys. J.; 158: 1151-60(Dec 1969).

Continuous radiation emitted by rotationally and tidally distorted stars as they appear in close binary systems was computed. Gray atmospheres with radiation incident at the surface were used. The equivalent width of a weak absorption line superposed on the atmosphere was also computed. Hydrostatic equilibrium was assumed throughout. For a system of similar early-type stars, large variations in the ultraviolet flux are predicted as a function of separation, angle of inclination, and orbital phase. For absorption lines with strong temperature dependence, significant variations of the equivalent width as a function of orbital phase are expected. An extremum in the equivalent width of the line should occur at one-half phase. (auth)

8255 OBSERVATIONAL RESULTS CONCERNING DEPARTURES FROM LTE IN LATE B STARS. Smith, Myron A. (Steward Observatory, Tucson, Ariz.); Strom Stephen E. Astrophys. J.; 158: 1161-5(Dec 1969).

Measures of the size of the Balmer and Paschen discontinuities were obtained for a number of B stars by use of an intermediate-band photometric system. The ratio of observed Paschen-to-Balmer discontinuities, ϕ, is shown to be a sensitive indicator of departures from LTE. The ϕ-values obtained from the observations are compared with the predictions of recently computed non-LTE models. It is concluded that the departures are negligible for stars less luminous than class III but are significant for supergiants. (auth)

8256 OPACITY-PROBABILITY DISTRIBUTION FUNCTIONS FOR CARBON MONOXIDE AT ELEVATED TEMPERATURES. Kunde, Virgil G. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J.; 158: 1167-76(Dec 1969).

Opacity-probability distributions were computed for $^{12}C^{16}O$ by the method suggested by Strom and Kurucz. The distribution functions were obtained from computed theoretical spectra of $^{12}C^{16}O$ at temperatures of 1680°, 2016°, 2520°, and 3360°K and at turbulent velocities of 0, 2, and 8 km sec^{-1}. Spectral intervals of 100 cm^{-1} were chosen for the band regions of the fundamental (1000 to 2400 cm^{-1}), the first overtone (2400 to 4400 cm^{-1}), and the second overtone (4500 to 6500 cm^{-1}). The contributions of all spectral lines at a given frequency were considered in computing the theoretical spectra of the line absorption coefficient. If only Doppler and turbulent line broadening are considered, the line absorption coefficient of CO is essentially zero over a significant fraction of the spectrum. This is due to the relatively large line separation (4 cm^{-1} for a rigid rotator) and to the rapid decrease of the Doppler wings. Thus the spectra and consequently the opacity-probability distribution functions are characterized by an absorption coefficient which varies through many orders of magnitude. A second trend evident in the opacity-probability distribution functions is the closing of the spectral gaps with increasing temperature and/or turbulent velocity. (auth)

8257 Z ANDROMEDAE: VARIATION OF EXCITATION FROM 1923 TO 1968 AND SPECTRA IN 1967 AND 1968. Bloch, M. (Observatoire, Lyon); Jousten, N.; Swings, J. P. Bull. Soc. Roy. Sci. Liege; 38: 245-54(1969). (In French).

There appears to be no periodicity in the presence of lines of different ionization stages and degrees of excitation in the spectrum of Z Andromedae. The variation of the excitation from 1923 to 1968 is discussed. The spectrum of Z Andromedae in 1967–1968 is described. (auth)

8258 RELATIVISTIC EQUATIONS FOR STRUCTURE OF RADIATIVE CONFIGURATIONS WITH SPHERICAL SYMMETRY AND SLOW MOTION. Demaret, J. (Univ., Liege). Bull. Soc. Roy. Sci. Liege; 38: 219-39(1969). (In French).

The equations of stellar structure in general relativity for spherically symmetric configurations in slow motion are derived from Einstein's gravitational field equations and conservation equations, written for Schwarzschild's coordinates. To include radiative transport, a term is introduced in the stress–energy tensor that represents radiation, obtained by applying Cherenkov's treatment of the relativistic gas in a gravitational field to a photon gas, and by using the thermodynamic equilibrium hypothesis and the diffusion approximation. This leads to a tensor that is the generalization of Thomas' tensor. The nuclear energy generation rate is introduced from the expression in general relativity of the equation of conservation of proper mass. The equations are then written for quasi-static configurations and the set of differential equations obtained can be applied to the construction of models of supermassive stars which, following Hoyle and Fowler, could explain the quasi-stellar radio sources. An equation of conservation of energy for the whole relativistic configuration is also derived and physically explained. (auth)

8259 THE UNUSUAL INFRARED OBJECT IRC+10216. Becklin, E. E. (California Inst. of Tech., Pasadena); Frogel, J. A.; Hyland, A. R.; Kristian, J.; Neugebauer, G. Astrophys. J.; 158: L133-7(Dec 1969).

IRC + 10216 is an extended object located out of the galactic plane in an unreddened region. At 5 μ it is the brightest source observed outside the solar system; at 2.2 μ it varies by as much as 2 mag, with a time scale on the order of 600 days. Its energy distribution resembles that of a 650°K blackbody, and no spectral features have been observed in the wavelength range from 1.5 to 14 μ. The object is interpreted as being consistent with a galactic source surrounded by an optically thick dust shell. (auth)

8260 HIGH-FREQUENCY STELLAR OSCILLATIONS. II. G44-32: A NEW SHORT-PERIOD BLUE VARIABLE STAR. Lasker, Barry M. (Univ. of Michigan, Ann Arbor); Hesser, James E. Astrophys. J.; 158: L171-3(Dec 1969).

The proper-motion star G44–32 is a variable one with amplitudes of about 2% and periods in the range from 10 to 27 min. (auth)

8261 STABLE MASSES AND RADII OF SUPER DENSE BARYON STARS. Libby, L. M. (Univ. of Colorado, Boulder. RAND Corp., Santa Monica, Calif.); Thomas, F. J. Phys. Lett., 30B: 400-1(Nov. 10, 1969).

Stable masses and radii of superdense baryon stars are computed from the isostatic relativistic equations of star equilibrium, using an equation of state for 45 baryon species and using the proton–proton interaction energy derived from high-energy elastic scattering up to 30 GeV. Masses for an interval of radius 5×10^4 cm < r < 10^5 cm are unstable, so that a degenerate star losing mass and approaching r of 5×10^4 cm suffers a partial collapse to half radius. (auth)

8262 EMISSION OF NEUTRINOS BY MASSIVE STARS AND SUPERNOVA. Kopysov, Yu. S.; Kuz'min, V. A. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1790-2(Nov. 1968). (In Russian).

Properties of neutron–proton plasma in the core of massive stars and supernovae and parameters of the stationary n–p plasma were studied previously, assuming kinetic equilibrium of β processes including the following reactions: $p + e^- \rightarrow n + \nu$, $n + e^+ \rightarrow p + \bar{\nu}$, and $n \rightarrow p + e^- + \bar{\nu}$. In addition to the above reactions, studies are reported here of β processes with participation of two nucleons: $n + n \rightarrow d + e^- + \bar{\nu}$, $n + n + e^+ \rightarrow d + \bar{\nu}$, $p + p \rightarrow d + e^+ + \nu$, and $p + p + e^- \rightarrow d + \nu$. (R.V.J.)

8263 EQUATION OF STATE AT SUBNUCLEAR DENSITIES. Langer, William D. (Goddard Inst. for Space Studies, New York); Rosen, Leonard C.; Cohen, Jeffrey M.; Cameron, A. G. W. Astrophys. Space Sci.; 5: 259-71(Nov 1969).

An equation of state for cold matter above white dwarf densities is evaluated. The gas is considered to be a mixture of degenerate neutrons, protons, and electrons combined with nuclei of one type (that is only one A and Z value). The equilibrium equations for the mixture are derived and the number densities as well as the A and Z of the nucleus are calculated along with an equation of state, which smoothly goes over to that of a neutron, proton, and electron gas mixture at a density of $\sim 5 \times 10^{13}$ g/cm^3. (auth)

8264 FORBIDDEN LINES OF NIIV IN THE SPECTRUM OF RR TELESCOPII. Lambert, D. L. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. Space Sci.; 5: 283-8(Nov 1969).

The rich spectrum of the slow nova RR Telescopii contains several strong unidentified lines. The possibility is re-examined that some of these lines are due to forbidden transitions of [NiIV]. Success is partial but the new identifications include four strong lines (5363, 5288, 5060, 5042) from the multiplet $a^4F - a^2G$. (auth)

8265 ON THE CONTINUUM AND THE ABSOLUTE MAGNITUDE OF ETA CARINAE. Viotti, R. (Laboratorio di Astrofisica, Frascati, Italy). Astrophys. Space Sci.; 5: 323-32 (Nov 1969).

The excitation temperature, color excess, and continuum of η Car in the visible and near ultraviolet were determined from the study of the excitation of the ionized iron emission lines. The excitation temperatures of Fe II and [Fe II] are about 8000°K, a value which is very much lower than the mean ionization temperature of the elements in η Car. E_{B-V} is about 1.1m; the absolute visual magnitude is presently -10.5 ± 1m. From the equivalent widths of the emission lines the true continuum between 1.5 and 3.0 μ^{-1} was derived. The corresponding B–V is –0.14m, while the Balmer jump is less than 0.5m. The continuum appears mainly nebular in origin with a strong contribution of the two-photon emission from the 2s level of hydrogen in the blue. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstract 8363.

8266 (AD-693053) POLARIZATION OF PULSATING RADIO SOURCES (8). Report No. 1969-8. Ekers, R. D.; Moffet, A. T. (Owens Valley Radio Observatory, Pasadena, Calif.). 1969. Contract N00014-67-A-0094. 23p. CFSTI.

The complete polarization characteristics of a number of pulsating radio sources were determined at 13 cm. Both a stable average and a time varying component of the polarized radiation were found. A change in the position angle of the linear component during the course of the pulse is a common property; however, the high degree of linear polarization and constant rotation of angle seen for PSR0833-45 is atypical. (auth) (USGRDR)

8267 (AD-694460) ENERGETIC GAMMA-RAY EMISSION FROM THE GENERAL DIRECTION OF THE CYGNUS CONSTELLATION. Valdez, J. V.; Freier, P. S.; Waddington, C. J. (Minnesota Univ., Minneapolis. Cosmic Ray Group). Jul 1969. Contracts Nonr-710(60); NGR-24-005-050. 16p. (CR-140). CFSTI.

A combination nuclear emulsion and spark chamber gamma-ray telescope was flown on a high altitude balloon to study a region in the constellation Cygnus for evidence of possible point- or line source emission of E > 100-MeV gamma rays. The region surveyed in this observation covered approximately 280° to 315° R. A. and 25° N to 45° N declination. In this region lie two potential point sources, Cyg A and Cyg XR-1, together with a section of the galactic longitudes of 60 to 90°. The response of the detector was calculated using a Monte Carlo simulation. This enables one to derive an energy spectrum and flux value for the general background of gamma rays, which are presumably atmospheric in origin. (auth) (USGRDR)

8268 SYNTHESIS OF BRIGHTNESS DISTRIBUTION IN RADIO SOURCES. Hogg, D. E.; MacDonald, G. H.; Conway, R. G.; Wade, C. M. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astron. J.; 1206-19(Dec 1969).

The results of the first synthesis of the brightness distributions of several strong radio sources with the NRAO three-element interferometer are presented. At 2695 MHz, the supernova remnant Cas A shows shell structure, while the remnant Tau A is more nearly a smooth ellipsoid, in agreement with previous work at lower frequencies. Structure of small angular scale is found within the components of the double sources Cyg A and Her A. Most of the flux from Vir A comes from an extended region surrounding the nucleus, but there are two point sources as well, one of which coincides with the nucleus, the other with the optically brightest knot in the jet. (auth)

8269 OBSERVATIONS OF THE STRUCTURE OF RADIO SOURCES IN THE 3C CATALOGUE. IV. CORRELATION DIAGRAMS AND THE EVOLUTION OF RADIO SOURCES. Longair,

M. S.; MacDonald, G. H. Mon. Notic. Roy. Astron. Soc.; 145: 309-25(1969).

The radio structures of a complete sample of 200 radio sources from the Revised 3C catalogue are now available with a resolution of 23″ × 23″ cosec δ from recent observations at 1407 MHz with the One-Mile telescope at Cambridge. These results are taken together with other data from long baseline interferometry and studies of interplanetary scintillation to derive correlation diagrams of radio luminosity against surface brightness and of radio luminosity against total linear size at 178 MHz and 1407 MHz. Particular attention is given to the proper selection of sources at different frequencies and the selection effects which can influence the correlation diagrams. It is shown that these correlation diagrams are well determined from the present data. Since the diagrams represent a complete sample of sources it is possible to make quantitative comparison between theories of the evolution of radio sources and the observations. A general procedure has been developed for testing theories in which the components of radio sources are ejected from the nuclei of radio and QSO's. In this analysis it is essential to incorporate the effects of cosmological evolution, which can considerably change the appearance of the predicted diagrams. It is shown that it is possible to account for a large part of the dispersion in the correlation diagrams as being due to the fact that sources are observed at different stages in their evolution. (auth)

8270 THEORY OF LUNAR OCCULTATION: NEW METHODS OF ESTIMATING BRIGHTNESS DISTRIBUTIONS AND THEIR WIDTHS. Lang, Kenneth R. (Stanford Univ., Calif.). Astrophys. J.; 158: 1189-98(Dec 1969).

In order to deduce new methods for determining brightness distributions and their widths, the formulae for the monochromatic radiation intensity at the Earth during the lunar occultation of a radio-frequency source are examined. It is shown that, when the source is sufficiently narrow, the oscillatory portion of the radiation intensity may be assigned an envelope amplitude and a phase for each value of time. Each complex number thus defined gives the amplitude and phase of one spatial Fourier component of the source brightness distribution. When the intensity is observed over a narrow band of frequencies, the oscillatory term of the monochromatic intensity is shown to be modified by multiplication with a certain function of frequency and bandwidth. In light of these derivations, a method is specified in this paper by which the Fourier components of the source brightness distribution may be obtained from the intensity observed as the source passes behind the Moon. Because only a finite number of data can be observed, spatial frequencies higher than a certain cutoff value are not available. An estimated brightness distribution, obtained by taking a Fourier transform of the available Fourier components of the source brightness distribution, is a convolution of the true brightness distribution with a function whose width depends on the number of data used. The Scheuer method of restoration results in a distribution that is the convolution of this estimated distribution with a Gaussian function. Both methods of determining brightness distributions have a resolution which depends on the number of useful data, and this number is shown to be a function of antenna aperture, source width, bandwidth, and noise. When source width is all that is required, only the inner part of the envelope of the intensity need be determined. Source widths obtained by directly comparing observed envelopes with theoretical ones compare well with scintillation observations. (auth)

8271 COLLECTIVE BREMSSTRAHLUNG FROM RELATIVISTIC ELECTRONS AS A POSSIBLE MECHANISM IN RADIO SOURCES. Papadopoulos, K. (Univ. of Maryland, College Park); Lerche, I. Astrophys. J.; 158: 981-6(Dec 1969).

The possibility of interpreting some of the radio emission from astrophysical plasmas as collective bremsstrahlung due to ultrarelativistic electron tails is discussed. It seems feasible that such a mechanism plays an important role in the radio emission from the "compact" source in the Crab Nebula, quasi-stellar objects, and the planet Jupiter. (auth)

8272 MEASUREMENTS OF FLUX DENSITY AND POLARIZATION OF VARIABLE SOURCES AT A WAVELENGTH OF 1.55 CENTIMETERS. McCullough, T. P.; Waak, J. A. (Naval Research Lab., Washington, D. C.). Astrophys. J.; 158: 849-57 (Dec 1969).

The flux density of the 1.55-cm radiation from the quasi-stellar sources 3C 273, 3C 279, and 3C 454.3 and the Seyfert galaxy 3C 84 was observed at intervals of about 2 months from 1966 May to 1968 May; measurements of linear polarization were made during the last half of this interval. Time variations of about 30% were found in the fluxes of these sources. In the case of 3C 273, two distinct maxima were observed, and there is some evidence that the cloud of relativistic electrons which produced the later peak originated at an earlier epoch than the cloud which caused the first observed peak. The measurements of linear polarization indicated a systematic variation in the polarization of 3C 454.3. (auth)

8273 PARTICLE ACCELERATION DURING THE 1966–1967 RADIO BURST OF 3C 273. Simon, M. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J.; 158: 865-9(Dec 1969).

The data at 3.4 mm for the 1966–1967 variable component of 3C 273 indicate that the model of an expanding source emitting synchrotron radiation is breaking down at early stages of the evolution of the source. It is shown that this is a natural consequence of the model and that it provides evidence for continued acceleration of relativistic electrons in the source during the first few months of observation. A value of 0.4 pc is derived for the intrinsic size of the source over which particle acceleration must have occurred. (auth)

8274 ACCURATE DISPERSIONS FOR THIRTEEN PULSARS. Goldstein, S. J.; James, J. T. (Univ. of Virginia, Charlottesville). Astrophys. J.; 158: L179-82(Dec 1969).

The dispersions of thirteen pulsars were determined with fractional accuracies between 2×10^{-3} and 1×10^{-4} from observations of strong individual pulses between 112 and 170 MHz. No variation with time or with pulse strength was detected. For six pulsars the dispersion obtained between 170 and 142 MHz differed from that obtained between 142 and 112 MHz by less than 1.0×10^{14} Hz, a value that sets an upper limit of about 10^7 cm^{-6} pc to the emission measure of dense plasma along the paths to these pulsars. (auth)

8275 SAGITTARIUS A: OBSERVATIONS OF THE GALACTIC CENTER AT 3.3 mm. Dworetsky, Michael M.; Epstein, Eugene E.; Fogarty, William G.; Montgomery, John W. (Aerospace Corp., Los Angeles, Calif.). Astrophys. J.; 158: L183-7 (Dec 1969).

Observations at 3.3 mm of the radio source Sagittarius A were used to obtain a flux estimate of $36(+10, -5) \times 10^{-26}$ W m^{-2} Hz^{-1}. This value was approximately half that predicted by extrapolation of results at longer wavelengths. The mean half-intensity diameter of Sgr A appeared to be smaller (<1′.6) at 3.3 mm than at longer wavelengths (~2′ × 3′ at 30 cm), supporting the suggestion of Maxwell and Taylor that the apparent size of Sgr A decreases with increasing radio frequency. (auth)

8276 SEARCH FOR LINE STRUCTURE IN THE X-RAY SPECTRUM OF SCO X-1. Holt, S. S.; Boldt, E. A.; Serlemitsos, P. J. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J.; 158: L155-8(Dec 1969).

Recently obtained data from a rocket-borne exposure to x rays from Sco X-1 are shown to yield a positive indication of iron line emission at 3.25 σ at a level approximately an order of magnitude below previously published upper limits. Such emission is consistent with a bremsstrahlung source of universal elemental abundance, but the overall continuum shape indicates significant departures from an isothermal source. (auth)

8277 BALLOON OBSERVATIONS OF A NEW-BORN X-RAY SOURCE. Thomas, R. M.; Buselli, G.; Clancy, M. C.; Davison, J. N. (Univ. of Adelaide). Astrophys. J.; 158: L151-4(Dec 1969).

A position for the x-ray source discovered by Conner, Evans, and Belian has been estimated from balloon observations to be $\alpha(1950) = 14h\ 57 \pm 6m$, $\delta(1950) = -30°.7 \pm 3°$; $l^{II} = 333°$, $b^{II} = +24°$. Estimates of the intensity of the source in different energy ranges are also given. (auth)

8278 PERIODIC VARIATIONS IN PULSAR RADIATION INTENSITY. Lang, Kenneth R. (Cornell-Sydney Univ. Astronomy Center, Arecibo , Puerto Rico). Astrophys. J.; 158: L175-7 (Dec 1969).

Power spectra of pulsar-intensity fluctuations at 318 MHz indicate that seven pulsars have line structure in their intensity spectra. Since two of these pulsars, AP 1237 + 25 and AP 2303 + 30 are newly discovered, their characteristic parameters are presented. The power spectra of CP 1919 + 21 and AP 2015 + 28 do not show features corresponding to the alias of the class 2 pulsation that is thought to cause subpulse structure. (auth)

8279 STUDY OF SEVERAL EMISSION NEBULAE IN THE Halpha-LINE BY MEANS OF A FABRY–PEROT INTERFEROMETER. Doroshenko, V. T. Sov. Astron. AJ (Engl. Transl.); 13: 427-32(Nov-Dec 1969).

Translated from Astron. Zh.; 46: 544-9(May-June 1969).

The results of observations of several H II regions carried out in summer and autumn of 1965 by means of a Fabry–Perot inter-

ferometer in the Hα line are discussed. The observations were carried out on the 125 cm (ZTE) and the 48 cm (AZT-14) reflectors of the Southern Station of the Shternberg State Institute of Astronomy and the 50-cm reflector of the observatory of the Astrophysical Institute of the Academy of Science of the Kazakh SSR. The halfwidth of the instrumental profile in this case was 13.7 km/sec. For the region St 18 (7h02m−10°23′) and the adjacent nebulae, it was found that the profile of the Hα lines is a Doppler profile, the halfwidth being 30 ± 3 km/sec and the radial velocity +12.4 ± 3.1 km/sec (St 18) and +8.4 ± 3.9 km/sec (St 12−17, 19). The Hα halfwidths for IC 1805−1795 and IC 1318 and the adjacent regions are 43.0 ± 4.0 and 30.4 ± 3.0 km/sec, and the radial velocities are −42.1 ± 3.4 and +0.4 ± 1.6 km/sec, respectively. (auth)

Solar Phenomena

Refer also to abstracts 8359 and 8365.

8280 (AD-687765) STUDIES ON ACTIVE SOLAR REGIONS WITH A VIEW TOWARD FLARE PRODUCTIVITY. Final Report. Billings, Donald E. (Colorado Univ., Boulder. Dept. of Astro-Geophysics). May 1969. Contract Nonr-1147(13). 9p. CFSTI.

Various investigations on active solar regions and a list of conclusions reached are summarized. One conclusion that is pointed out is that there is a good correlation between the length of neutral lines in the magnetic field in active regions and the flare productivity of the region. (auth) (USGRDR)

8281 (AD-693126) THE PENETRATION OF SOLAR WIND HYDROGEN TO 300 KM. Technical Report, August 1968–January 1969. Ialongo, Gilbert (Aerospace Corp., El Segundo, Calif.). 1 Jul 1969. Contract F04701-69-C-0066. 42p. (TR-66(5260-20)-3; SAMSO-TR-69-231). CFSTI.

The penetration of the neutral component of the solar wind is analyzed as a function of depth of penetration in the magnetosphere and exosphere. The fast neutral H atoms collide with thermal H, He, N, O, and their ions and are partly changed into fast protons by charge-changing collisions. As the density of the ions and atoms surrounding the Earth changes with local time, month, and year of observation, the attenuation of the energetic neutrals is a time-dependent phenomenon. Calculations were carried out for the year of the largest solar activity, and the results show that an equilibrium condition is reached in which the incident beam is less than 20% ionized. Conditions of near equilibrium are reached at altitudes of 320 km in the morning hours and 400 km in the afternoon hours. (auth) (USGRDR)

8282 (N-69-38771) ON THE MAGNETIC CONFIGURATION OF SUNSPOT GROUPS WHICH PRODUCE SOLAR PROTON FLARES. Sakurai, Kunitomo (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Jun 1969. 21p. (NASA-TM-X-63697). CFSTI.

The configuration of sunspot magnetic fields is deduced by using the observational data on the development of type 4 radio bursts and Hα brightening areas over the umbrae of sunspot groups. Since both polarity areas are existent together within the same umbrae, the magnetically neutral regions are usually produced along the areas separating the one polarity area from the other. In the eastern portion of the preceding sunspots, the gradient of sunspot magnetic fields is much steeper compared to all other portions and thus solar proton flares are triggered within or very near this portion. Hα-brightening areas develop mainly above the preceding sunspots and their eastern portion of sunspot groups. This tendency seems to be closely related to the configuration of sunspot magnetic fields and the mechanism of solar proton flares. (auth) (STAR)

8283 (N-69-39365) ROCKET STUDIES OF X RAYS FROM THE NONFLARING SUN. Final Report. Acton, Loren W. (Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.). 27 Sep 1969. Contract NASw-1398. 39p. (NASA-CR-106267; LMSC-N-A-3-69-1). CFSTI.

A series of 3 rocket flights were carried out for the purpose of measuring the high-energy tail of the x-ray spectrum of the quiescent Sun. This emission is shown to be highly variable in intensity and slope but with spectral distributions which may be adequately described in terms of thermal bremsstrahlung. Incidental to the solar measurements data were obtained on several discrete cosmic x-ray sources and the diffuse cosmic x-ray background. The time-integrated x-ray emission of the Crab Nebula and the diffuse cosmic emission can both be described in terms of power law spectra with intensity and slope in essential agreement with the results of other workers. (auth) (STAR)

8284 ASPECTS OF N-S ASYMMETRY OF SOLAR FLARES ASSOCIATED WITH GEOPHYSICAL EFFECTS OF THE ELECTROMAGNETIC AND CORPUSCULAR RADIATION. Maris, Georgeta; Dinulescu, Vasile. Stud. Cercet. Astron.; 14: No. 1, 45-8(1969). (In Rumanian).

This paper is an application of relations previously established by using data on solar flares and their geophysical effects in the period 1957−1963. A difference appears concerning the N−S asymmetry between the flares followed by electromagnetic radiation effects (SWF) and the flares producing geocorpuscular effects (PCA and geomagnetic storms). For the former flares, there is no difference between their N−S asymmetry and general asymmetry which is deduced from all flares, but, for the latter flares a difference exists. This difference is ascribed to the increase in the flares asymmetry with the increase in their importance, as well as to the fact that the corpuscular effects are especially associated with the great flares. For peculiar flares—followed by the occurrence of combined Type II−Type IV bursts—that cause magnetic storms at the Earth, the two asymmetries are approximately equal. (auth)

8285 HEATING OF SOLAR CHROMOSPHERE. Gruber, Gary Richard. New York, N. Y.; Yeshiva Univ. (1969). 260p. Thesis.

It is believed that the heating of the solar chromosphere is primarily due to the deposition of the energy of shock waves. The purpose of this thesis is to critically investigate the Sturrock Mach 1 hypothesis. The proposed condition (Mach 1) for which a sound wave forms a shock is used in connection with a static model of the Sun (neglecting the solar wind) which contains no magnetic field. In this model, radiative emission, thermal conduction, and various degrees of reflection (planar) of sound waves are taken into account. Compairing this model to observation, a critical analysis of the Mach 1 hypothesis is given. In particular, it is found that coronal temperatures higher than the order of 50,000 °K cannot be generated. If a low-temperature corona (50,000 °K) is not permitted, a model of the low chromosphere is obtained which agrees remarkably with the very recent 1968 Bilderberg model. It is found that the required sound energy flux (emanating from the hydrogen convection zone) is 7.07×10^6 ergs/sec cm^2, which can be compared to Athay's estimate of 4.2×10^6 ergs/cm^2 sec. (Diss. Abstr.)

8286 APOLLO 11 SOLAR WIND COMPOSITION EXPERIMENT: FIRST RESULTS. Buehler, F. (Univ., Bern); Eberhardt, P.; Geiss, J.; Meister, J.; Signer, P. Science; 166: 1502-3(19 Dec 1969).

The helium-4 solar-wind flux during the Apollo 11 lunar surface excursion was $(6.3 \pm 1.2) \times 10^8$ atoms per square centimeter per second. The solar-wind direction and energy are essentially not perturbed by the Moon. Evidence for a lunar solar-wind albedo was found. (auth)

8287 A STUDY OF THE DEPTH DEPENDENCE OF SOLAR TURBULENCE FOUND BY USING GOLDBERG'S METHOD. Dunn, Anne Roberts. Troy, N. Y.; Rensselaer Polytechnic Inst. (1969). 204p. Thesis.

The so-called "Goldberg" or "profile intercomparison" method of determining Doppler widths from spectral line profiles was studied by using it to analyze a group of good quality solar profiles observed for that purpose with the McMath solar telescope at the Kitt Peak National Observatory. The observations consisted of profiles of fourteen lines of calcium, chromium, and iron, made at four or five positions on the solar disk. Of these, eight lines of calcium and chromium proved suitable for the intended analysis. A depth dependence of solar microturbulence could not be derived by applying the Goldberg method to a single pair of lines at a single disk position. When the depth dependence was determined from different disk positions, instead of from different residual intensities within a single line pair, a depth-dependent turbulence model was obtained. The model finally derived was an anisotropic model whose turbulent velocities in both radial and tangential components increase with increasing depth in the atmosphere. The uncertainty in the radial component is estimated to be ±0.3 to ±0.5 km/sec; the uncertainty in the tangential component is estimated at ±0.6 to ±1.0 km/sec. The maximum velocity found in each component is about 4.5 km/sec, so these uncertainties are large. They are attributed mostly to inconsistency between the profiles observed at different disk positions and to errors in the f-values used in the Goldberg method analysis. Detailed calculations of line profiles were made with three turbulence models for six of the observed profiles at each observed disk position. Two of the models were anisotropic, one of them being the model derived from the Goldberg method analysis. The third was isotropic. None of the models gave satisfactory fits to all the profiles, but the anisotropic models were judged more successful than the isotropic model. The Goldberg method can be useful for finding approximate Doppler widths and approximate depth distributions of

turbulent velocity in the solar atmosphere, but it is easy to obtain misleading results. The application of the method must be painstaking, and the results must be interpreted carefully. (Diss. Abstr.)

8288 SOLAR-WIND OBSERVATIONS WITH SATELLITE ESRO HEOS-1 IN DECEMBER 1968. Bonetti, A.; Moreno, G.; Cantarano, S.; Egidi, A.; Marconero, R.; Palutan, F.; Pizzella, G. (Consiglio Nazionale delle Ricerche, Bologna. Consiglio Nazionale delle Ricerche, Florence. Univ., Florence). Nuovo Cim.; 64B: 307-23(11 Dec 1969).

Preliminary results from the solar-wind experiment S.73 on board of satellite HEOS-1 of the European Space Research Organization are presented. The detector consists of a hemispheric electrostatic deflector for energy selection and a Faraday cup for flux measurements. The energy distribution of the positive component from 200 to 15,000 eV is thus obtained. Protons and α particles in the interplanetary region are easily detected. Bulk velocity, density, and most probable thermal velocity of the proton component outside the shock front are determined for the period December 9 through December 31, 1968. It is found that the properties of the solar wind during a period near the solar maximum are similar to the general properties during previous years, except for a somewhat smaller density. (auth)

8289 NEUTRAL NEON IN THE VISIBLE SOLAR SPECTRUM. Dietz, R. D.; Orrall, F. Q. (Univ. of Hawaii, Honolulu). Astrophys. J.; 158: 1239-42(Dec. 1969).

A faint emission line at λ6402.2 occasionally appears in the spectrum of bright solar prominences. Calculations support the suggestion that the line is due to Ne I. (auth)

8290 REVISED SOLAR ABUNDANCE OF IRON AND THE SOLAR NEUTRINO FLUX. Watson, William D. (Massachusetts Inst. of Tech., Cambridge). Astrophys. J.; 158: L189-91(Dec 1969).

The influence on the solar-core opacity of the revised photospheric abundance of iron is investigated. Within the inner 0.3 $M_\odot$ of current models for the present Sun, the Rosseland opacity is found to be increased by about 25% as a result of bound-free absorption by the iron. This change is estimated to double the predicted value for the neutrino flux in the ^{37}Cl experiment relative to that obtained by using otherwise "best values" for all physical parameters. This is roughly 30% above the latest published value, and three times the probable upper limit from the observations. (auth)

8291 RAPID FINE STRUCTURE IN A BURST OF HARD SOLAR X-RAYS OBSERVED BY OSO-5. Frost, Kenneth J. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J.; 158: L159-63(Dec 1969).

A number of bursts of hard solar x rays have been observed in nine channels simultaneously covering the energy range from 14 to 250 keV. The spectra of these bursts were sampled for 0.2 sec every 1.8 sec. One such burst, of 9-min duration, with an intensity-time profile having a complex, quasi-periodic structure, is presented. A mechanism based on the repetitive production of monoenergetic electrons is qualitatively shown to explain the time structure of the x-ray burst. (auth)

8292 ENERGETIC X-RAY AND EXTREME-ULTRAVIOLET FLASHES OF SOLAR FLARES. Donnelly, Richard F. (Space Disturbances Lab., Boulder, Colo.). Astrophys. J.; 158: L165-7 (Dec 1969).

Extreme-ultraviolet flashes from solar flares and x rays of energies ≥50 keV exhibit similar, concurrent impulsive fine time structure. The extreme-ultraviolet enhancement observed by means of sudden frequency deviations is compared with hard-x-ray observations for the Hα class 2B flare of 1816 U.T. August 8, 1968, when the ratio of the enhancement of energy flux in the wavelength range 1 to 1030 Å to the hard-x-ray energy flux was about 10^4. (auth)

8293 C V SPECTRA NEAR THE 1s–2p LINE OF C VI. Feldman, Uri (Tel Aviv Univ., Israel. Goddard Space Flight Center, Greenbelt, Md.); Cohen, Leonard. Astrophys. J.; 158: L169-70(Dec 1969).

Seven lines of C(V) near the 1s–2p line of C(VI) were measured. The lines were first reported by Edlén and Tyrén. Six of them are identified as belonging to transitions of the types 1s2s–2s2p, 1s2p–$2p^2$, and 1s3s–2p3s. (auth)

8294 FORBIDDEN LINES IN SOLAR ABSORPTION. Swings, Jean Pierre (Univ., Liege). Mem., Acad. Roy. Belg., Cl. Sci., Coll. 8, 38: No. 3, 1-57(1969). (In French).

The forbidden lines in solar absorption were studied on the basis of high-resolution direct photoelectric recordings made with the spectrograph at Jungfraujoch Scientific Station and with the solar telescope of the Kitt Peak National Observatory. A detailed study was made of the forbidden lines of the elements O I, N I, C I, Fe II, Ni II, Si I, S I, and Ca II. The presence of these lines in the solar absorption spectrum is first discussed. Possible incidences of the existence of these lines with respect to the abundance of these elements and the deviations from local thermal equilibrium are considered. (tr-auth)

8295 ION CYCLOTRON RESONANT INSTABILITY OF RH WAVES PROPAGATING AT AN ANGLE TO THE INTERPLANETARY MAGNETIC FIELD. Cuperman, S.; Landau, R. W. (Tel-Aviv Univ., Israel). Astrophys. Space Sci.; 5: 333-41(Nov 1969).

The anomalous Doppler-shift interaction between positive ions and right-hand (rh) polarized EM waves propagating at a small angle to a static magnetic field is investigated. The linear rate of growth of the resulting instability is obtained and compared with the growth rate for the parallel propagation case. For conditions typical of the solar wind at about 1 au, the rate of growth always decreases with increasing propagation angle. For very large ion pressures ($\beta_{||} \gg 1$) and temperature anisotropies ($T_{||}/T_{\perp} \gg 1$), the rate of growth may increase with increasing propagation angle. (auth)

8296 DIFFUSION COEFFICIENTS FOR SOLAR COSMIC PARTICLES IN THE INTERPLANETARY SPACE. Charakhch'yan, A. N.; Charakhch'yan, T. N. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1776-82(Nov. 1968). (In Russian).

Experimental data on the time-dependent intensity of solar protons recorded in space by satellites, sounding balloons, and balloons in the stratosphere were examined. The studies were limited to the available data on the proton intensities in the maximum time dependences. Thirty-four time dependences of 15 events of cosmic-ray bursts are analyzed. The curves of the time-dependent proton intensities for the bursts of Feb. 23, 1956, May 4, 1960, July 20, 1961, Nov. 10, 1961, Feb. 5, 1965, July 7, 1966, and Jan. 1, 1967 were analyzed. The results of measurements of $t \geq t_{max}$ are described satisfactorily by diffusion formulae with the parameter β close to $\beta = 0.5$ and 1. Curves for the length of proton scattering paths were constructed as functions of proton pulses and of the number of solar spots η for protons with 0.6 BeV/c pulses. Tabulated data confirmed the dependence of l_0 variation on solar activity. The length of the mean free path increased with the reduced solar activity. (R.V.J.)

Galaxies

Refer also to abstracts 8249 and 8275.

8297 (AD-693052) THE NATURE OF THE FAR INFRARED RADIATION OF THE GALACTIC CENTER (7). Report No. 1969-7. Lequeux, James (Owens Valley Radio Observatory, Pasadena, Calif.). 1969. Contract N00014-67-A-0094. 15p. CFSTI.

The strong far-infrared emission at the galactic center by Hoffmann and Frederick (1968) is shown to be probable emission by dust particles; the large total mass of these particles suggests that the mass of the interstellar medium at the center of the Galaxy may be larger than indicated by the 21-cm line observations. (auth) (USGRDR)

8298 (AD-694383) AGE OF COSMIC RAYS AND ABUNDANCE OF ANTIMATTER IN OUR GALAXY. Libby, L. Marshall (RAND Corp., Santa Monica, Calif. Colorado Univ., Boulder). Sep 1969. 8p. (P-4198). CFSTI.

Acceptance of a disc–halo structure for the Galaxy together with cosmic-ray evidence leads to the conclusion that cosmic rays are very old, older than 100 million years, and to the conclusion that the abundance of antimatter in the entire Galaxy is less than 0.0003. (auth) (USGRDR)

8299 (N-69-39359) POSSIBLE VARIATIONS OF HELIUM CONTENT WITH POSITION IN THE GALAXY. Shipman, H. L.; Strom, S. E. (Smithsonian Astrophysical Observatory, Cambridge, Mass.). Sep 1969. 16p. (NASA-CR-106229). CFSTI.

The helium abundances for 94 Population-I B stars were determined from observations of He I λ4471 line strengths. The mean helium abundance of this sample of stars is 0.115 ± 0.003 (p.e.) by number fraction or 0.331 by mass fraction. The data also suggest that the helium abundance varies from one OB association to another by as much as 0.02 in number fraction. Furthermore, the Perseus arm of the Galaxy seems to be overabundant in helium by 0.013 in number fraction. The helium overabundance in this arm suggested from the B-star data is further supported by the observed increase in high-amplitude, short-period Cepheids in the

Perseus arm, which can be interpreted in terms of enhanced initial helium content. (auth) (STAR)

8300 INTERSTELLAR POLARIZATION IN THE DIRECTIONS OF GLOBULAR CLUSTERS M3 AND M13. Dyck, H. Melvin; McClure, Robert D. (Kitt Peak National Observatory, Tucson, Ariz.). Astron. J.; 74: 1177-8(Dec 1969).

Interstellar polarization in the directions of M3 and M13 was measured and found to be less than 0.002 mag. The minimum value of the reddening derived from these measurements is E(B–V) = 0.01 mag, in good agreement with the low values of reddening recently determined by several other observers. (auth)

8301 PHOTOGRAPHIC PHOTOMETRY OF A GALACTIC STAR FIELD NEAR NGC 1669. Fang, Christopher Chong-yen. Philadelphia; Univ. of Pennsylvania (1968). 121p.

Thesis.

Three-filter photometry on the RGU system was applied to a star field in the anticenter region on the galactic plane. The color excesses and the absolute magnitudes of stars in the field were determined by discussion of the RGU two-color diagram. The density function was derived up to 5 kpc from the Sun. The luminosity function derived and the luminosity function of the solar neighborhood are in fairly good agreement. (Diss. Abstr.)

8302 A STUDY OF ABSORPTION AND REDDENING USING ABSOLUTE MAGNITUDES AND COLORS OF GALAXIES. Peterson, Bruce Alrick. Pasadena, Calif.; California Inst. of Tech. (1969). 88p.

Thesis.

For the brightest galaxy in each of 48 nearby clusters and 7 groups of galaxies photoelectric measurements of V and V–4 magnitudes were made. Redshifts were measured for those 39 clusters and 3 groups which did not have previously published redshifts. Absolute magnitudes and colors were calculated for each cluster, and the cscb dependence of the absolute magnitudes and colors was attributed to galactic absorption. After correcting for selection effects, the ratio of total to selective absorption was found to be $A_V/E_{V-r} = 3.9$ which is consistent with $A_V/E_{B-V} = 3.0$. The values found for the color-excess and absorption at the galactic pole are $E_{V-r} = 0.016$ and $A_V = 0.06$. This value for the color-excess is in agreement with $E_{B-V} = 0.03$ found by Sturch for the RR Lyrae stars. (Diss. Abstr.)

8303 INTERSTELLAR IONIZED HYDROGEN. Symposium Held in Charlottesville, Virginia, December 8–11, 1967. Terzian, Yervant (ed.). New York; W. A. Benjamin, Inc. (1968). 782p. (CONF-671222).

This volume presents the proceedings of the NRAO and Arecibo Symposium on interstellar ionized hydrogen. It consists of seven sessions, each one dealing with some topic of the interstellar medium. Among the topics discussed are the observations of regions related to star formation, the evolution of ionized interstellar clouds, the radio recombination lines of interstellar hydrogen, the large-scale distribution of ionized hydrogen in the Galaxy, and the OH emission. (W.D.M.)

8304 EMISSION-LINE OBJECTS PROJECTED UPON THE GALACTIC BULGE. Herbig, G. H. (Univ. of California, Santa Cruz). Proc. Nat. Acad. Sci. U. S.; 63: 1045-50(Aug 1969).

Low-dispersion slit spectrograms were obtained of 34 faint objects that lie in the direction of the galactic bulge and have the Hα line in emission upon a detectable continuum. Eleven of these are certain or probable symbiotic stars. A rough comparison with R CrB stars in the same area suggests that these brightest symbiotics in the bulge have in the mean $M_v \approx -3$ to -4, which suggest Population II red giants rather than conventional Population I M-type objects. The sample also contains a number of hot stars having H and [O II] or [O III] in emission, as well as four conventional Be stars, and six certain or possible planetary nebulae. (auth)

8305 GROUP VELOCITY OF SPIRAL WAVES IN GALACTIC DISKS. Toomre, Alar (Massachusetts Inst. of Tech., Cambridge). Astrophys. J.; 158: 899-913(Dec 1969).

Studied here are density waves of the kind proposed especially by Lin to explain the spiral structures of disk galaxies. It is shown that any packet of such waves propagates radially (and toward increasingly short wavelengths) with a group velocity that is sufficient to obliterate it within a few galactic revolutions. This does not necessarily mean that the density-wave hypothesis is wrong. But it does imply that any existing spiral waves in the disk of a galaxy must somehow be replenished if their pattern as a whole is to persist. Three conceivable sources of such replenishment are also discussed in this paper. (auth)

8306 APPLICATION OF THE DENSITY-WAVE THEORY TO THE SPIRAL STRUCTURE OF THE MILKY WAY SYSTEM. II. MIGRATION OF STARS. Yuan, C. (Massachusetts Inst. of Tech., Cambridge). Astrophys. J.; 158: 889-98(Dec 1969).

The history of the migration of a star can be traced with confidence provided the following items are known with sufficient accuracy: its age, its present location, its present velocity, and the gravitational field in which it moves. Strömgren and his collaborators have determined these stellar data for a number of stars. Orbits and places of origin are now calculated for twenty-five of them by using the Schmidt model for our Galaxy. The results show that these stars are born in the spiral arms (as expected) only if the density-wave theory is adopted and the effect of the spiral gravitational field is included. Calculations are actually carried out with logarithmic spiral patterns, which are found to approximate extremely well those obtained theoretically from the dispersion relation of Lin and Shu with assigned pattern speeds. The spiral pattern adopted agrees with that determined simply by comparison with observed distribution of neutral hydrogen and young stars. It is also found that the strength of the spiral gravitational field is limited to a range of 4 to 7% of the symmetrical field. With the present observational evidence, the final value adopted for the pattern speed is 13.5 km sec^{-1} kpc^{-1}, and for the ratio of field strength, 5%. The spiral pattern corresponds to that on an infinitesimally thin disk at about 11.5 km sec^{-1} kpc^{-1}. (auth)

8307 APPLICATION OF THE DENSITY-WAVE THEORY TO THE SPIRAL STRUCTURE OF THE MILKY WAY SYSTEM. I. SYSTEMATIC MOTION OF NEUTRAL HYDROGEN. Yuan, C. (Massachusetts Inst. of Tech., Cambridge). Astrophys. J.; 158: 871-88(Dec 1969).

When a density-wave pattern is present in a disk galaxy, the motion of the interstellar gas will systematically deviate from the mean circular motion. This systematic deviation is studied in this paper in considerable detail from both the theoretical and the observational points of view. The tangential component of this systematic motion furnishes a completely new method for identifying the spiral structure of the Milky Way system; this method is applied to the determination of the locations of the Sagittarius arm and the Norma-Scutum arm. A fairly detailed discussion is given to compare observational data with a theoretical spiral pattern for the Milky Way system based on the density-wave theory and the 1965 Schmidt model. The spiral pattern is estimated to travel at 13.5 km sec^{-1} kpc^{-1} for the Milky Way system; this estimation includes the effects of gas and finite thickness. This corresponds to that of an infinitesimally thin stellar disk traveling at 11.5 km sec^{-1} kpc^{-1}. (auth)

8308 EVIDENCE FOR THE EJECTION OF MATTER FROM THE NUCLEUS OF THE SEYFERT GALAXY NGC 4151. Anderson, Kurt S.; Kraft, Robert P. (Lick Observatory, Santa Cruz, Calif.). Astrophys. J.; 158: 859-64(Dec 1969).

At least three shell lines of He I ($\lambda_0$3889) arising from the metastable 2^3S state are found in absorption in the spectrum of the nucleus of NGC 4151. Corresponding shell lines of hydrogen are found or suspected to exist in at least Hβ and Hγ. Velocities of ejection of up to –970 km sec^{-1} are measured. If the mass of the nucleus is $\lesssim 10^9$ $M_\odot$, much of the mass will be ejected to infinity at an estimated rate of between 10 and 10^3 $M_\odot$ yr^{-1}. (The lower limit is based on an assumed radius of 5 pc for the source of ionizing radiation.) No absorption lines have been detected corresponding to material recycled into the nucleus. The amount of neutral hydrogen in the nucleus, consistent with the strengths of these shell lines, is sufficient to explain the wide Balmer wings as a result of electron scattering. (auth)

8309 EQUIPARTITION AND THE FORMATION OF COMPACT NUCLEI IN SPHERICAL STELLAR SYSTEMS. Spitzer, Lyman Jr. (Princeton Univ. Observatory, N. J.). Astrophys. J.; 158: L139-43(Dec 1969).

In a spherical system composed of stars of two masses, m_1 and m_2, with m_2 greater than m_1, the heavier stars will lose kinetic energy with a time constant about twice the equipartition time, t_{eq}, and will gravitate toward the center. It is shown that if M_2, the total mass of the heavier stars, exceeds a certain critical value, the self-attraction of these stars requires such a large rms velocity dispersion that equipartition with the lighter stars becomes impossible. This critical value equals $\beta(m_1/m_2)^{\frac{1}{2}}M_1$, where M_1 is the corresponding total mass of the lighter stars and β is a numerical constant less than unity that equals 0.16 when m_2/m_1 is large. When M_2 exceeds this value, the subsystem of heavy stars continues to contract with a time constant about equal to t_{eq}, forming a dense nucleus within the core of the system. Application of this criterion to the mass distribution for newly created stars suggests

that equipartition is impossible initially for all young systems. The formation and continuing contraction of a dense nucleus of heavy stars is likely to be important in the dynamical evolution of galactic and globular clusters and of galactic nuclei. (auth)

Cosmology

8310 INFRARED AND MICROWAVE ASTRONOMY. Feldman, P. A.; Rees, M. J.; Werner, M. W. (Inst. of Theoretical Astronomy, Cambridge, Eng.). Nature (London); 224: 752-8 (22 Nov 1969).

Recent observations of infrared and microwave emission from various astronomical objects, together with their theoretical implication, were discussed at a conference held in Cambridge from July 8 to 11, 1969. This rapidly developing field of astronomy promises to contribute significantly to an understanding of the formation and evolution of not only stars and galaxies but also the Universe itself. (auth)

8311 A MEASUREMENT OF THE COSMIC MICROWAVE BACKGROUND RADIATION AT WAVELENGTHS OF 1.58 cm AND 3.3 mm. Stokes, Robert Allan. Princeton, N. J.; Princeton Univ. (1969). 98p.

Thesis.

In an effort to delineate the spectrum of the cosmic black-body radiation, radiometer measurements were made at $\lambda \approx 1.58$ cm and $\lambda = 3.3$ mm. The results for the thermodynamic radiation temperature fit a 2.7°K black-body spectrum over this wavelength range. In particular, a hot greybody spectrum does not fit the results. The experiments were performed at high-altitude laboratories in order to reduce atmospheric emission, which is a major limitation at short wavelengths. An experimental approach felt to be free of major systematic errors was developed and is described in detail. The construction of Dicke radiometers and accompanying low-temperature reference sources is outlined. The testing of the critical components, the antenna, the reference termination, and the mixer, is dealt with in some detail. A description of checks on and measurement of systematic errors is included. It was necessary to measure and subtract off the radiation due to oxygen and water vapor in the atmosphere; the theoretical sky model and the measurement are discussed. An outline of the computer program which convolved the antenna gain pattern with the atmospheric model is included. The techniques employed in fabrication of 90 GHz mixer diodes are described. (Diss. Abstr.)

8312 CLUSTERS OF GALAXIES: THEIR STATISTICS AND FORMATION. Yu, Jer Tsang. Princeton, N. J.; Princeton Univ. (1968). 141p.

Thesis.

Although modern cosmology generally starts from the view that the Universe is homogeneous and isotropic, one of the greatest challenges is to understand the observed very irregular distribution of matter, in galaxies and clusters of galaxies. An important observational question here is whether the distribution of matter shows any tendency to clustering on a scale still larger than that of the rich cluster. It has been suggested that "superclusters" of clusters may exist, but this conclusion is far from being certain because of the considerable danger of systematic errors in the data. A new statistical test was applied here to the observed distribution of the clusters. The results suggest that any tendency toward superclustering is scarcely above that to be expected for a random distribution of the rich clusters. To all appearances, the great clusters of galaxies might be at the upper limit of the observable density inhomogeneities in the present Universe. An attempt was made to see how this result fits in with the gravitational instability picture for the formation of galaxies and clusters of galaxies. To this end, the history of evolution of a whole range of plane wave components of some initial density fluctuations in a Friedmann Universe was traced out. The effects which the expansion of the Universe and the eventual decoupling between the matter and radiation have on the spectrum of this initial perturbation were determined. Depending on the choice of the initial spectrum, this can result in the introduction of a correlation length comparable to the size of the great clusters of galaxies. Apparently, the gravitational instability picture can give a reasonable accounting for the structures of the Universe, including the lack of strong clustering beyond the great clusters. (Diss. Abstr.)

8313 COSMOLOGY AND QUANTUM ELECTRODYNAMICS. Davies, P. C. W. (University Coll., London). Nature (London): 224: 1102(13 Dec 1969).

An approach is described to develop a quantum theory of the Wheeler–Feynman direct interparticle action electrodynamics using an S-matrix perturbation expansion. Such an approach provides confirmation of the work of Hoyle and Narlikar (Nature 219: 340(1968) and 222: 1040(1969), and Ann. Phys. 54: 207(1969)) and possesses the following advantages: (1) it uses a formulation familiar in the conventional treatment of quantum electrodynamics; (2) particle wave functions are second quantized, and the theory can be made fully relativistic; (3) the solution is completely general; (4) the simplicity and familiarity of many of the expressions provide a ready comparison with the conventional theory. A brief outline is given of this S-matrix approach. (UK)

8314 ON THE LOCALLY ELLIPSOIDAL SOLUTIONS OF LIOUVILLE'S EQUATION IN STELLAR DYNAMICS. Truemper, Manfred (North Texas State Univ., Denton). Astrophys. J.; 158: 915-23(Dec 1969).

Any locally ellipsoidal distribution of residual velocities is shown to be of the Chandrasekhar type $\Psi(Q + N)$ if it satisfies Liouville's equation (with gravitational potential only). Some of Chandrasekhar's results on ellipsoidal distributions are rederived in a simplified manner. Further, it is shown: (i) The function N has vanishing substantial derivative; i.e., an observer who travels with the mean velocity finds in a small volume around him at any time the same number of particles with zero residual velocity. (ii) The isotropic expansion velocity of a small comoving volume in the mean velocity field depends on the ellipsoid Q only. (iii) The space-independent part of the velocity ellipsoid must be positive definite if Q is assumed to be positive definite. Finally, sufficient conditions for the mean velocity field to be homogeneous are given. (auth)

8315 MULTIFLUID COSMOLOGIES. Hughston, Lane P. (Southwest Center for Advanced Studies, Dallas). Astrophys. J.; 158: 987-9(Dec 1969).

A new coordinate system which synthesizes all previous work on multifluid cosmologies is presented. Using these coordinates in the Robertson–Walker, Bianchi Type I, and some nonrotating line elements, noninteracting mixtures of multicomponent fluids with the γ law and polytropic equations of state are investigated. (auth)

8316 THE ENERGY–MOMENTUM COMPLEX IN THE BRANS–DICKE THEORY. Nutku, Yavuz (Univ. of Chicago). Astrophys. J.; 158: 991-6(Dec 1969).

A symmetric energy–momentum complex, similar to the Landau–Lifshitz complex in general relativity, is obtained for the Brans–Dicke theory. An evaluation of this complex shows that the conservation laws in the post-Newtonian approximations of this theory follow the same scheme as in general relativity and may be obtained in a similar way. (auth)

8317 GRAVITATIONAL RADIATION FROM DENSE STAR CLUSTERS. Greenstein, George (Yeshiva Univ., New York). Astrophys. J.; 158: L145-9(Dec 1969).

The pulsed gravitational radiation that Weber has recently observed almost certainly does not arise from binary encounters between stars in a nonrelativistic star cluster. The relativistic case is quite unlikely but is not explicitly ruled out. Relativistic clusters evolve extremely rapidly by star-star collisions and loss of energy by gravitational radiation; only very massive clusters are able to withstand these effects. (auth)

Planetary Phenomena

Refer also to abstract 7663.

8318 NEW CIRCULAR-POLARIZATION MEASUREMENTS OF JUPITER'S DECIMETER RADIATION. Gary, B.; Gulkis, S. (California Inst. of Tech., Pasadena). Astrophys. J.; 158: L193-5(Dec 1969).

Circular-polarization measurements of Jupiter at a wavelength of 13 cm were made during April and May 1969, with the 210-foot radio telescope at Goldstone, California. An upper limit to the net degree of circular polarization in the integrated emission is 1% over a limited longitude-range. (auth)

Atomic and Molecular Physics

8319 PHYSICS 1969: A SURVEY. Phys. Bull. (London): 20: 500-9(Dec 1969).

Brief surveys are included, by various authors, of the following fields: atomic and molecular physics; solid-state physics; magnetism; low-temperature physics; x-ray analysis; high-temperature plasma physics; nuclear structure; particle physics; vacuum physics; and electron microscopy and probe analysis. (UK)

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

Refer also to abstracts 8425, 8551, 8595, and 8596.

8320 (LA-4280) MOLECULAR BEAMS FROM LONG PARALLEL TUBES. Brainerd, John P. (Los Alamos Scientific Lab., N. Mex.). 5 May 1969. Contract W-7405-eng-36. 6p. Dep. CFSTI.

Molecular beams from long parallel tubes, a new development in beam formation, were investigated for use in a mass spectrometer. Gas-beam flux distributions from a glass-tube bundle, two collimated-hole structures, and a long single tube were measured. The distributions of the multichannel sources compared favorably with the theory of Giordmaine and Wang within the experimental error. (auth)

8321 PENETRATION OF HEAVY IONS INTO COPPER, SILVER, AND GOLD. Zarutskii, E. M. (Leningrad Polytechnic Inst.). Sov. Phys.-Solid State (Engl. Transl.); 11: 1362-5(Dec 1969).

Translated from Fiz. Tverd. Tela; 11: 1684-8(Jun 1969).

The depths of penetration and energy spectra of rubidium and cesium ions having energies up to 20 keV were measured by bombarding thin free films of copper, silver, and gold. Conclusions were drawn regarding the elastic character of interaction of these ions with the metal structures. A summary table is given listing mean free paths, including results obtained earlier for 18 ion–metal combinations. The results are compared with the theoretical values obtained by proceeding from the screened Coulomb Thomas–Fermi potential. (auth)

Atomic and Molecular Properties

Refer also to abstracts 8689 and 8703.

8322 (LA-4297) SELF-CONSISTENT FIELD HARTREE CALCULATIONS FOR ATOMS AND IONS. Larson, Allen C.; Waber, James T. (Los Alamos Scientific Lab., N. Mex.). 21 Oct 1969. Contract W-7405-eng-36. 169p. Dep. CFSTI.

The wave functions, eigenvalues, and values of $\langle r^n \rangle$ have been calculated, through use of the Hartree model, for more than 500 different configurations of atoms and ions from atomic numbers 1 to 128. The various assumptions used and many of the problems encountered in this type of calculation are discussed. Procedures are suggested to solve the problem of slow convergence encountered with atoms such as copper. The results for hydrogen-like ions obtained from the programs are compared with analytic numbers. The effect of the convergence criterion on the "stability" of solutions was examined for the series iron, nickel, and cobalt, and the results are discussed. On the computer used, the IBM 7094, a self-consistent test more stringent than 10^{-5} failed to improve the expectation values significantly. Various effects of changing the assumed electronic configuration are examined. (auth)

8323 (UCRL-19328) SECOND-ORDER CORRECTIONS TO THE FINE-STRUCTURE OF HELIUM. Hambro, Lars (California Univ., Berkeley. Lawrence Radiation Lab.). Aug 1969. Contract W-7405-eng-48. 93p. Dep. CFSTI.

Thesis.

The fine-structure constant can be determined to high accuracy from precise measurements of the fine-structure of the 2^3P level in helium. One of the necessary calculations is to compute the contributions from the six Breit operators and the mass polarization operator in second-order perturbation theory. The eighteen spin-dependent perturbations from intermediate ^3P states are calculated by solving an inhomogeneous Schrödinger equation for the perturbation of the wave function by the variational method. The second-order contributions are then given by a single integral. These corrections are first calculated using standard Hylleraas expansions with up to 165 terms for the perturbed wave functions, resulting in contributions to the two fine-structure intervals of the order of 10^{-4} cm^{-1}, but only four of the results are sufficiently accurate. These variational calculations are improved by including additional terms, reflecting the singularities of the Breit operators, in the expansions. With this refinement another five contributions are obtained to the accuracy of 10^{-6} cm^{-1} required by the larger fine-structure interval. It will require much more effort to match the experimental precision of 10^{-7} cm^{-1} in the smaller interval, but it is shown that the second-order perturbations of the larger interval can be calculated accurately enough to permit a new high-precision determination of the fine-structure constant. (auth)

8324 (UCRL-Trans-10422) MEASUREMENT OF THE RELATIVE INTENSITIES OF X-RAY LINES OF THE L SPECTRUM OF HEAVY ELEMENTS EXCITED BY ELECTRON BOMBARDMENT. Goldberg, M. Translated by W. Robinson for Univ. of California, Lawrence Radiation Lab., Livermore, from Ann. Phys. (Paris); 7: 329-57(1962). 86p. Dep. CFSTI.

An abstract of the original paper appeared previously as NSA 17: 12825.

8325 AB INITIO CALCULATION OF HARMONIC FORCE CONSTANTS. II. APPLICATION TO GAUSSIAN WAVE FUNCTIONS FOR H_2^+. Bishop, David M.; Macias, A. (Univ. of Ottawa). J. Chem. Phys.; 51: 4997-5001(1 Dec 1969).

The method of Bishop and Randić for evaluating force constants by direct differentiation and using only the ground-state wave function for the molecule in its equilibrium configuration is extended so as to handle wave functions built from a nonorthogonal basis set. The results are applied to a series of Gaussian wave functions for H_2^+. (auth)

8326 THEORETICAL INVESTIGATION OF THE TRANSITION PROBABILITIES IN THE HYDROGEN MOLECULE. Wolniewicz, L. (Univ. of Chicago). J. Chem. Phys.; 51: 5002-8 (1 Dec 1969).

The electronic transition moments for the B–X, C–X, and E, F–B transitions in the hydrogen molecule are given for several internuclear separations, $R \leq 12$ a.u. The electronic transition moments are used for the computation of the transition moments for individual vibrational and rotational lines. The results show that, except for the Werner bands, the relative intensities cannot be accurately represented by the Franck–Condon factors. It is not possible to make a definite quantitative comparison of the present results with experiment due to a significant R dependence of the electronic moments. Qualitatively, the results agree well with experiment. However, they do not explain the fact that the lowest vibrational levels in the F state have not yet been observed. (auth)

8327 CLASS OF POTENTIALS FOR THE DESCRIPTION OF THE INTERACTION BETWEEN TWO ATOMS. Kawatra, M. P. (Fordham Univ., Bronx, N. Y.); Lebedeff, S. A. J. Chem. Phys.; 51: 4744-50(1 Dec 1969).

A combination of potential forms to represent the potential between two atoms is proposed. These potential forms have the great advantage that, first, they have a fairly small number of parameters and, second, they are very convenient for further analysis. The potential forms are such that the corresponding Schrödinger equations can be solved exactly except in one case. The convenient mathematical form of the potential would enable one to interpret and analyze the energy and the angular momentum dependence of the scattering data with great ease. An attempt was made with a good degree of success to fit these potentials in the case of H_2, H_2^+, and CO and the possible relationship between the various potential parameters and the spectroscopic constants was studied. (auth)

8328 LOWER BOUNDS FOR EXPECTATION VALUES. Wang, P. S. C. (Univ. of Manchester, Eng.). J. Chem. Phys.; 51: 4767-9(1 Dec 1969).

The low-bound formula for expectation values proposed recently by the author is applied to various powers of r_1 and r_{12} in the normal helium atom, and the results are compared with those obtained previously by Jennings and Wilson and by Weinhold for the same problem. (auth)

8329 UPPER AND LOWER BOUNDS TO LONG-RANGE INTERMOLECULAR POTENTIALS. McQuarrie, D. A.; Terebey, J.; Shire, S. J. (Indiana Univ., Bloomington). J. Chem. Phys.; 51: 4683-6(1 Dec 1969).

The moment method developed by Gordon is used to calculate upper and lower bounds to the coefficient of R^{-8} in the expansion of the interatomic potentials of the systems, H–H, H–He, and He–He. (auth)

8330 $K\alpha_2/K\alpha_1$ X-RAY INTENSITY RATIOS FOR $Z > 50$. Nelson, G. C.; Saunders, B. G. (Univ. of California, Livermore). Phys. Rev.; 188: 108-12(5 Dec 1969).

The $K\alpha_2/K\alpha_1$ x-ray intensity ratios for 36 elements between Sb and Am were measured with a Cauchois-type bent-crystal spectrometer and a Ge(Li) detector. The present experimental results are systematically 5 to 10% higher than the values reported by Beckman and by Wapstra et al., but agree within experimental errors with the recent theoretical calculations of Scofield. (auth)

8331 STARK EFFECT IN HYDROGENIC ATOMS: COMPARISON OF FOURTH-ORDER PERTURBATION THEORY WITH WKB APPROXIMATION. Bekenstein, J. D.; Krieger, J. B.

(Polytechnic Inst. of Brooklyn). Phys. Rev.; 188: 130-9 (5 Dec 1969).

The Schrödinger equation for a hydrogenic atom in a uniform electric field is separated in parabolic coordinates, and WKB quantization rules are obtained for two of the separated equations. In the weak-field limit, the quantization rules are expanded in powers of the field and evaluated analytically. From the results, a power series for the energy eigenvalues is obtained, which agrees with all known results of perturbation theory to fourth order. For strong fields, the quantization rules are evaluated numerically for states for which the perturbation series is expected to be least accurate. It is found that the perturbation results to fourth order agree with the numerical results for the energy eigenvalues to one part in a thousand for the highest fields possible, and that the addition of the fourth order in perturbation theory improves the accuracy of the perturbation series, contrary to the conclusions of an earlier work. Finally, the accuracy for the measurement of fields from observed Stark shifts by using the perturbation theory is estimated. (auth)

8332 CLASSICAL-PATH CALCULATION OF THE S MATRICES FOR STARK BROADENING OF THE LYMAN-α LINE. Bacon, M. E. (Aerospace Research Labs., Wright-Patterson AFB, Ohio); Shen, K. Y.; Cooper, J. Phys. Rev.; 188: 50-6 (5 Dec 1969).

The S matrices for Stark broadening of the n = 1 and n = 2 levels of hydrogen based on the straight-line classical-path model are calculated numerically. The interaction terms (excluding exchange) are included to all orders, and time ordering of the operators in the S matrix is retained. The resultant values for the impact-broadening operator Φ are presented. These results are compared with previous approximations based on the same model. The effect of the present calculations on the center and near wings of the Lyman-α line profile is considered. (auth)

8333 $K\alpha_1$ AND $K\alpha_2$ X-RAY ENERGIES OF NEPTUNIUM, PLUTONIUM, AND AMERICIUM. Nelson, G. C.; Saunders, B. G.; John, W. (Univ. of California, Livermore). Phys. Rev.; 188: 4-6(5 Dec 1969).

The $K\alpha_1$ and $K\alpha_2$ x-ray energies of Np, Pu, and Am have been measured with a Cauchois-type bent-crystal transmission spectrometer. The energies of these transitions have been determined to an accuracy of 5 eV. The $K\alpha_1-K\alpha_2$ differences agree within the experimental error with differences obtained from the previously reported L x-ray energies. (auth)

8334 ONE-DIMENSIONAL HYDROGEN ATOM. Haines, Larry K.; Roberts, David H. (Amherst Coll., Mass.). Amer. J. Phys.; 37: 1145-54(Nov 1969).

The time-independent Schroedinger equation is solved for the bound-state solutions of the one-dimensional Coulomb potential, $-e^2/|x|$. The wave functions obtained are normalizable and continuous. The energy spectrum consists of a set of discrete levels with energies equal to the Bohr energies of hydrogen, and a set of continuum levels with energies lying strictly between the discrete levels. The odd wave functions associated with the discrete levels are differentiable everywhere, but the even wave functions associated with the continuum levels have a cusp with infinite slope at the origin. The energy levels are not degenerate. Following the method of Loudon, the bound-state solutions of a truncated Coulomb potential $-e^2/(|x| + a)$, $a > 0$, are also obtained. For small a, the discrete spectrum of this potential contains: (1) energy levels that approach arbitrarily close to the discrete levels of the true Coulomb potential as $a \to 0$, with odd wave functions identical to the odd wave functions of the true Coulomb potential at $a = 0$; (2) energy levels that approach arbitrarily close to the discrete levels of the true Coulomb potential as $a \to 0$, with even wave functions that are not the even wave functions of the true Coulomb potential at $a = 0$; and (3) a ground-state level belonging to an even wave function with an arbitrarily large binding energy as $a \to 0$. The ground-state energy is quite sensitive to the actual value of a chosen. It is concluded that the solution to the one-dimensional hydrogen atom shows a critical dependence on the detailed behavior of the Coulomb potential at small distances. (auth)

Positronium, Muonium, and Mesic Atoms and Molecules

Refer also to abstract 8584.

8335 INTERACTIONS OF AN αK^-e^- ATOM WITH A He ATOM. Russell, J. E. (Univ. of Cincinnati). Phys. Rev.; 188: 187-99(5 Dec 1969).

The potential between an αK^-e^- atom and a He atom is estimated by using perturbation theory. Only those states of the αK^-e^- atom in which the K^- meson is in a circular orbit with principal quantum number n = 27, 28, or 29 are considered. An estimate is also made of the atomic matrix element for Stark transitions. Perturbation theory is used to calculate the αK^-e^-–He interatomic potential, because it appears to give fairly reliable results for the H–He potential and because, in the particular states that are considered here, there is reason to believe that the αK^-e^- atom may be chemically somewhat similar to the ground state of the H atom. The results that are obtained indicate that the αK^-e^-–He potential, like the H–He potential, is probably repulsive, except at large internuclear separations where long-range dispersion forces are dominant. The results are used elsewhere to argue that Stark transitions are likely to be suppressed, and that the rather large value of the measured mean cascade time for K^- mesons in atomic orbits in liquid helium may, as suggested by Condo, be due to the occasional formation of a metastable state of the αK^-e^- atom. (auth)

8336 2p — 1s PIONIC TRANSITION. Anderson, D. K.; Jenkins, D. A.; Powers, R. J. (Virginia Polytechnic Inst., Blacksburg). Phys. Rev., 188: 9-16(5 Dec 1969).

In an attempt to get better agreement between the theoretical predictions and the observed energies and widths of 2p — 1s pionatomic transitions, the Klein–Gordon equation was numerically integrated assuming the optical model for the strong interaction potential. The interaction was characterized by six s-wave and four p-wave parameters. The available data from ^{18}B to ^{24}Mg was used to perform a least-squares fit of the s-wave parameters. Agreement was found between the observed shifts and the present predictions, and the real parts of the s-wave parameters agree well with those predicted by Ericson and Ericson. However, the predicted widths vary as much as 50% from the observed widths and very poor agreement was found between the imaginary s-wave parameters and Ericson and Ericson's predictions. (auth)

8337 POSITRONIUM BUBBLES IN LIQUID AND SOLID ^{4}He. Hernandez, John P.; Choi, Sang-il (Univ. of North Carolina, Chapel Hill). Phys. Rev.; 188: 340-8(5 Dec 1969).

A theoretical investigation of positronium atoms localized within bubbles, in condensed helium, has been carried out in order to compare it with recent experiments. The theory explores the size of the bubbles and the implications of the localization that are relevant to experiments on the angular correlation of the two annihilation photons. Pressure dependence is explored in a range from the vapor pressure to 170 atm at temperatures of 1.7 to 4.2°K. Theoretical predictions at thermal equilibrium yield excellent agreement with experiment except for two small, though notable, features. Agreement between theory and experiment can be made complete by noting that some annihilations will occur during the formation of a bubble and by assuming that the region adjacent to the bubble may not have quite enough time to come into thermal equilibrium with the bulk helium before the singlet positronium annihilates ($\tau \sim 10^{-10}$ sec). Further, the degree of nonthermalization must increase 1.7 and 4.2°K. Theoretically, nonthermalization effects are indeed expected to be more evident when the thermal conductivity is low [$\kappa(4.2°K) \simeq 10^{-2}\kappa(1.7°K)$ in the solid at 140 atm]; this suggests further experiments to test the hypothesis. (auth)

Collision Phenomena

Refer also to abstract 8816.

8338 (UCRL-19108) INELASTIC SCATTERING OF MOLECULAR IONS. Cheng, Mien-Hsiung (California Univ., Berkeley. Lawrence Radiation Lab.). Oct 1969. Contract W-7405-eng-48. 84p. Dep. CFSTI.

Thesis.

An ion-beam–collision-cell method was used to measure the angular and energy distributions of NO^+, N_2O^+, and D_2O^+ inelastically scattered from He. A primary ion energy range of 35 to 200 eV was investigated. The angular distributions in the center of mass coordinate system were compared with two classical models: the hard-sphere collision model and the effective collision-energy model. The former gave an upper limit to the observed angular distributions. The effective collision energy method, which made use of the breathing-sphere assumption for the diatomic molecule and employed an approximation similar to that of Takayanagi in the modified wave number approximation, gave results that agreed excellently with the experimentally measured angular distributions. The relative kinetic energy loss of inelastically scattered ions at 180° (cms) agreed reasonably well with exact classical calculations for a collinear collision. A nonmonotonic behavior of energy transfer was found for N_2O^+ and D_2O^+ at relative energies below 9 eV, where the relative kinetic energy loss increased with the decrease of the relative energy. Some angular and energy distributions of the fragment ions from

the collision-induced dissociation of NO^+, N_2O^+, and N_2^+ with He were also studied in the primary ion energy range of 125 to 225 eV. The peak velocities of the fragment ions lay very close to the initial beam velocities. In addition, the velocity distributions of the fragment ions were not symmetric with respect to the observed peaks. The data showed a rather long tail on the low-velocity side of the peak. The corresponding high-velocity branch was almost missing. The calculated relative kinetic energies of the dissociated products using Bailey's two-step model were found to be small, with about 0.1 eV for N^+ from 150-eV N_2^+, 0.8 eV and 1.2 eV for O^+ and N^+, respectively, from 225-eV NO^+. The results were explained in terms of stripping collisions. (auth)

8339 ELECTRON-IMPACT EXCITATION CROSS SECTIONS OF THE LOWEST-LYING TRIPLET STATES OF BENZENE. Matsuzawa, Michio (Tokyo Univ.). J. Chem. Phys.; 51: 4705-9(1 Dec 1969).

Calculations of electron-impact excitation cross sections of the lowest-lying triplet states $^3B_{1u}$, $^3E_{1u}$, $^3B_{2u}$ of benzene are carried out, using the Ochkur and Ochkur–Rudge approximations. Electronic wave functions are constructed from the LCAO molecular orbitals for π electrons in benzene, and nuclear motions are disregarded. It is found that the differential cross section has a peak at a large scattering angle in the low-energy region. The angular distribution for the excitation of the $^3B_{1u}$, $^3E_{1u}$ states shows a broad subsidiary peak at a larger scattering angle. As the incident energy is lowered, the position of the peak in the angular distribution shifts towards larger scattering angles, and the subsidiary peak tends to vanish. The total excitation cross section for the lowest-lying triplet states is about πa_0^2 at low incident energy. Results of calculations are discussed and compared with experimental findings. (auth)

8340 QUANTUM VIBRATIONAL TRANSITION PROBABILITIES IN ATOM–DIATOMIC MOLECULE COLLISIONS. II. LINEAR AND MULTISTEP INTERMOLECULAR POTENTIALS. Cheung, Agnes S.; Wilson, David J. (Univ. of Rochester, N. Y.). J. Chem. Phys.: 51: 4733-43(1 Dec 1969).

Three methods for the calculation of vibrational transition probabilities in collinear atom–diatomic molecule collisions are outlined. These are based on the approximation of the intermolecular potential by terms that permit the solution of the Schrödinger equation by separation of variables in each of several regions into which the configuration space of the system is divided. Boundary conditions between the regions lead to systems of linear equations the solutions to which yield quantities from which the transition probabilities are easily obtained. Plots of transition probabilities for various repulsive intermolecular potentials are shown and discussed. (auth)

8341 NONITERATIVE SOLUTIONS OF INTEGRAL EQUATIONS FOR SCATTERING. I. SINGLE CHANNELS. Sams, W. Neal; Kouri, Donald J. (Univ. of Houston, Tex.). J. Chem. Phys.; 51: 4809-14(1 Dec 1969).

A new method (homogeneous integral solution) for solving collision problems utilizing an integral equation formalism is presented. The approach is noniterative and applies equally well to purely local interactions or problems with combined local and nonlocal interactions. The method involves transforming the integral equation of scattering into a Volterra integral equation of the second kind. It follows that even for nonlocal interactions, the wave function may be determined noniteratively from knowledge of its value at a single point (the origin). A simple numerical procedure is proposed for solution of the Volterra equation, which allows one to avoid matrix inversions completely. At the end of the calculation, the scattering T or R matrix is obtained directly from the solutions. The method is illustrated by a calculation of the singlet and triplet s-wave Hartree–Fock phase shifts for electron–H-atom scattering. (auth)

8342 NONITERATIVE SOLUTIONS OF INTEGRAL EQUATIONS FOR SCATTERING. II. COUPLED CHANNELS. Sams, W. Neal; Kouri, Donald J. (Univ. of Houston, Tex.). J. Chem. Phys.; 51: 4815-19(1 Dec 1969).

The recently developed method of homogeneous integral solutions for solving integral equations of scattering is extended to include coupled channels. The formalism is developed in matrix notation and applies without change both to purely local interactions and to combined nonlocal and local interactions. A numerical quadrature method for solving the integral equations is presented. This method does not require iteration or matrix inversions. Further, during the entire calculation of the wave function and T (or R) matrix elements, only one or two matrix inversions need be performed (in the case of purely local or local + nonlocal interactions, respectively). It is expected that the method will provide a particularly efficient means of solving coupled equations for scattering problems. (auth)

8343 ATTACHMENT OF SLOW ELECTRONS TO OXYGEN MOLECULES. Herzenberg, A. (Yale Univ., New Haven). J. Chem. Phys.; 51: 4942-50(1 Dec 1969).

The attachment of electrons to O_2 molecules to form stable O_2^- ions is discussed by supposing that the electron is first captured to form an unstable negative molecular ion in a compound state, which is later stabilized in a collision with another molecule. The rate of initial capture is described by a Breit–Wigner formula, and the rate of formation of stable O_2^- ions is obtained by multiplying by the probability that a stabilizing collision should occur before the ion re-emits its extra electron. The lifetime of the compound state, which would be difficult to calculate reliably, cancels out the resulting expression. If one supposes all collisions of unstable ions to be stabilizing, one obtains an upper bound of the order of 10^{-30} cm^6 sec^{-1} for the rate constant for the formation of stable O_2^-. The experimental value is of this order. (auth)

8344 QUANTUM VIBRATIONAL TRANSITION PROBABILITIES IN ATOM–DIATOMIC MOLECULE COLLISIONS. III. REACTIVE SCATTERING. Wilson, David J. (Univ. of Rochester, N. Y.). J. Chem. Phys.; 51: 5008-14(1 Dec 1969).

The methods of Diestler and McKoy and Cheung and Wilson are combined to yield a procedure for calculating vibrational transition probabilities for inelastic reactive and nonreactive collisions. The model treated is that of a collinear collision between an atom and a diatomic molecule. The procedure should result in marked reductions in the computer time and core requirements for such calculations. An alternative method based solely on the approach of Cheung and Wilson is also developed; this method requires that the potential-energy surface in the vicinity of the transition state be approximated by a quadratic form and should permit extremely rapid computation of reactive-scattering transition probabilities. A second alternative method based on the use of the Born approximation in the vicinity of the transition state is also discussed. (auth)

8345 ION–MOLECULE REACTIONS, $He^+ + O_2$ AND $He^+ + N_2$, AT THERMAL ENERGIES AND ABOVE. Heimerl, J.; Johnsen, R.; Biondi, Manfred A. (Univ. of Pittsburgh). J. Chem. Phys.: 51: 5041-8(1 Dec 1969).

The rate coefficients for the reactions of He^+ ions with N_2 and O_2 have been measured in a drift tube–mass spectrometer from thermal energies (300°K) to ~0.1 eV. In addition to reaction-rate determinations by the usual product-ion "arrival spectrum" method, a new technique involving "additional residence time" for the parent ion is described, which is applicable even when parent and product ions have equal mobilities. The total rate coefficient (i.e., the sum of dissociative and the ordinary charge transfer) for $He^+ + N_2$ reaction was found to be $(1.0 + 0.3, -0.2) \times 10^{-9}$ cm^3/sec at 300°K, decreasing to $\sim 7 \times 10^{-10}$ cm^3/sec at 0.1 eV. The corresponding coefficient for the $He^+ + O_2$ reaction was measured to be $(8.5 + 2.5, -2.0) \times 10^{-10}$ cm^3/sec and to be independent of energy over the same range. The ratio of dissociative charge transfer (with N^+ or O^+, respectively, as reaction products) to ordinary charge transfer (with N_2^+ or O_2^+, respectively, as products) was found to be 0.55/0.45 for $He^+ + N_2$ and 0.8/0.2 for $He^+ + O_2$. (auth)

8346 TEMPERATURE DEPENDENCE OF DISSOCIATIVE ATTACHMENT IN O_2 AND CO_2. Spence, D.; Schulz, G. J. (Yale Univ., New Haven). Phys. Rev.; 188: 280-7(5 Dec 1969).

The onset, the shape, and the absolute magnitude of dissociative-attachment cross sections in O_2 and CO_2 have been determined as functions of gas temperature. The range of temperatures is 300 to 1000°K. In O_2, the onset of dissociative attachment is lowered from 4.4 eV at 300°K to 3.5 eV at 1000°K, in good agreement with O'Malley's theory. In CO_2, the first onset of O^- production occurs at 3.85 eV for a gas temperature of 300°K and at 3.35 eV for a gas temperature of 950°K. The onset extrapolates to 4.1 eV at 0°K. The magnitude of the cross section of the first peak in CO_2 increases monotonically with temperature, whereas the magnitude of the second peak decreases in the range 300 to 500°K, and then increases. It is found that the control of gas temperature, i.e., the control of the distribution of rotational and vibrational excitations of the target molecules, is necessary for an understanding of dissociative-attachment processes, and for the determination of certain molecular constants from such experiments. (auth)

8347 TOTAL AND EXCITATION-TRANSFER CROSS SECTIONS FOR COLLISIONS BETWEEN 2^3S METASTABLE AND GROUND-STATE HELIUM ATOMS. Evans, S. A.; Lane, Neal F. (Rice Univ., Houston, Tex.). Phys. Rev.; 188: 268-79(5 Dec 1969).

Total and excitation-transfer cross sections for collisions between 2^3S metastable and ground-state helium atoms were calculated in the perturbed-stationary-state approximation, using the best available adiabatic $^3\Sigma_u^+$ and $^3\Sigma_g^+$ potential curves for He_2, and

in the "diabatic" approximation, using a repulsive $^3\Sigma_g^+$ curve, constructed so as to have the appropriate united-atom limit. Both the total and excitation-transfer cross sections are found to show an oscillatory energy dependence. The detailed nature of these oscillations is found to be different for the adiabatic and "diabatic" descriptions. However, the average magnitude of the cross sections does not show this sensitivity. Differential cross sections have also been calculated and show considerable structure. Existing experimental measurements are included and compared with these calculations. (auth)

8348 CROSS SECTIONS FOR SOME N_2 AND N_2^+ EMISSIONS INDUCED IN AN N_2 TARGET BY 20- TO 100-keV H^+ AND H IMPACT. Gardiner, H. A. B.; Pendleton, W. R. Jr.; Merrill, J. J.; Baker, D. J. (Utah State Univ., Logan). Phys. Rev.; 188: 257-68(5 Dec 1969).

Absolute emission cross sections for nine N_2^+ first negative bands ($v' = 0 \rightarrow v'' = 0, 1, 2, 3$, and $v' = 1 \rightarrow v'' = 0, 1, 2, 3, 4$) were determined under single-collision conditions in the excitation of ground-state N_2 molecules by a beam of 20- to 100-keV protons. Emission cross sections for the (0, 0) band of the N_2^+ first negative system and the (0, 2) band of the N_2 second positive system resulting from fast hydrogen-atom impact on ground-state N_2 molecules were obtained through the use of a charge-exchange model that predicted the observed variation of emission intensity with N_2 pressure. The model also yielded values for the sum of the cross sections for electron capture and loss by fast hydrogenic beam particles traversing N_2. An upper limit of 4×10^{-20} cm^2 was established for the emission cross section of the (0, 2) N_2 second positive band resulting from 100-keV proton impact. (auth)

8349 ELECTRONIC TRANSITIONS IN SLOW COLLISIONS OF ATOMS AND MOLECULES. II. CALCULATIONS OF WAVE FUNCTIONS AND GREEN'S FUNCTIONS IN THE EIKONAL APPROXIMATION. Chen, Joseph C. Y. (Univ. of California, San Diego, La Jolla); Watson, Kenneth M. Phys. Rev.; 188: 236-56(5 Dec 1969).

Practical techniques are developed for evaluating wave functions and Green's functions using the eikonal approximation. It is assumed that the scattering angle is small. This provides a great simplification in analysis of the trajectory curves, radii of curvature, etc. A sequence of approximations and the use of variational principles are described. Numerical illustrations, particularly for proton–hydrogen–atom scattering, are given for several of the approximations. (auth)

8350 DEPOLARIZATION CROSS SECTIONS FOR THE METASTABLE NOBLE GASES BY OPTICAL PUMPING. Schearer, L. D. (Texas Instruments Inc., Dallas). Phys. Rev.; 188: 505-6(5 Dec 1969).

The relaxation times of optically oriented metastable atoms of Ne, Ar, and Xe in buffers of noble gases were measured, and depolarization cross sections obtained. The cross sections range from 0.43×10^{-16} cm^2 for Ne^m–He collisions to 190×10^{-16} cm^2 for Xe^m–Xe. (auth)

8351 TEMPERATURE DEPENDENCE OF ELECTRON ATTACHMENT IN I_2 VAPOR. Truby, F. K. (Sandia Labs., Albuquerque, N. Mex.). Phys. Rev.; 188: 508-12(5 Dec 1969).

The temperature dependence of electron attachment in I_2 vapor has been measured over the temperature range from 253 to 467°K. The attachment coefficient was found to increase with temperature over the range studied, varying from 0.9×10^{-10} to 4.2×10^{-10} cm^3/sec. Studies involving selective heating of the electrons indicate that for a gas temperature of 298°K the attachment coefficient increases from 1.8×10^{-10} to 2.8×10^{-10} cm^3/sec as the electron thermal energy was increased from 0.04 to about 0.27 eV. (auth)

8352 CLASSICAL CALCULATIONS ON ELECTRON CAPTURE FROM VAPORIZED SODIUM, MAGNESIUM, AND ALUMINUM. Mapleton, Robert A. (Air Force Cambridge Research Labs., Bedford, Mass); Grossbard, Neil. Phys. Rev.; 188: 228-32(5 Dec 1969).

In three previous papers, Bates and Mapleton modified the original theory of Thomas to obtain improved classical cross sections for capture of electrons from neutral atoms by protons into all classically bound states of the hydrogen atom. The cross sections containing (i) no provision for separate subshells in the atomic target, and (ii) provision for these subshells, are labeled Q(T1) and Q(T2), respectively. In the present paper these cross sections are reported for capture from the vaporized atoms Na, Mg, and Al, in the range of impact energies $4 \text{ keV} \leq E \leq 1 \text{ MeV}$. These calculated cross sections for Mg are compared with the total cross sections Q(expt), measured by Berkner et al., for $5 \text{ keV} \leq E \leq 70 \text{ keV}$. The ratios $R = Q(T2)/Q(\text{expt})$ are within the limits $0.44 \leq R \leq 2.2$ for E in the range $10 \text{ keV} \leq E \leq 70 \text{ keV}$; however, Q(T1) disagrees markedly with Q(expt). According to these, and previous, calculations, the onset of 2p-orbital capture [$Q(2p) \geq 0.07\,Q(T2)$] occurs approximately at E = 35, 60, 100, and 350 keV for Na, Mg, Al, and Ar, respectively. In a comparison of the constituent cross sections of Al with Ar, moreover, we find that Q(3s) exceeds Q(3p) for E > 25 keV in the case of Al; but in the case of Ar, Q(3p) dominates Q(3s) for E < 1.75 MeV. From the results of previous extensive calculations on N, O, Ne, Mg, and Ar by one of us, and by Hiskes, for E < 1 MeV, fairly good agreement is found among Q(expt), Q(T2), and the prior form of the Oppenheimer–Brinkman–Kramers cross sections adjusted with ratios obtained from Born calculations on H. However, for E > 1 MeV, only the latter method predicts Q(expt) with qualitative success. (auth)

8353 ACCURATE LOW-ENERGY ATOM–ATOM SCATTERING. Mittleman, Marvin H. (City Coll., New York). Phys. Rev.; 188: 221-7(5 Dec 1969).

Measurements of low-temperature thermodynamic properties of gases yield information concerning the pairwise scattering parameters of the atoms of the gas. For recent helium-gas experiments, the He–He scattering potential has been determined with a high degree of accuracy. This necessitates a reanalysis of low-energy He–He scattering theory with inclusion of previously neglected effects of order m/M. The formulation requires a nonlinear transformation of coordinates to ensure the correct form of the incident wave, and a novel definition of the adiabatic Hamiltonian to ensure the dissociation of the "molecular" states into correct atomic states. In addition to the usual nonadiabatic terms, additional terms of the same order not usually encountered are found. They are necessary to make the potentials vanish at infinity. It is shown that the procedure of determining a potential interaction from the second virial coefficient (scattering data) and then predicting bound-state properties (if any) is a correct one. (auth)

8354 EXCITATION OF VIBRATIONAL MODES NEAR THRESHOLD IN CO_2 AND N_2O. Stamatovic, A.; Schulz, G. J. (Yale Univ., New Haven). Phys. Rev.; 188: 213-16(5 Dec 1969).

The vibrational cross section by electron impact within 0.05 eV of threshold is measured in CO_2 and N_2O. A trochoidal monochromator is used as an electron source and SF_6 gas is used as a scavenger of zero-energy electrons appearing as a result of vibrational excitation of the molecules. It is found that the cross section near the threshold of all fundamental modes is of the same order. This indicates that the Born theory using a dipole interaction is not applicable for optically forbidden modes near threshold in CO_2, but it appears that it is applicable for optically active modes, both at threshold and at high energies. The theory is not expected to hold near resonances. (auth)

8355 BOUND–BOUND TRANSITIONS IN HYDROGENLIKE ATOMS INDUCED BY FAST CHARGED PARTICLES. Omidvar, Kazem (Goddard Space Flight Center, Greenbelt, Md.). Phys. Rev.; 188: 140-51(5 Dec 1969).

Considering the transition from the nl level in a hydrogen-like atom to the n'l' level induced by fast charged particles of mass M, charge z, and energy E, when $(M/\mu)(\Delta E/E) \ll 1$, with μ the electronic charge and ΔE the excitation energy, the excitation cross section can be written $Q_{BB}(nl,n'l') = (Mz/\mu Z)^2 E^{-1}[A(nl,n'l') \ln E + B(nl,n'l')]$, where Z is the nuclear charge, and A(nl,nl') and B(nl,n'l') are some constants. In this paper, an analytic expression for A(nl,n'l') and B(nl,n'l') is found. These coefficients, after being averaged with respect to l and summed with respect to l', are given numerically for n = 1 to 9 and for a range of n' from n + 1 to 20. Also, the Born cross sections $Q_B(n,n')$ for many transitions are given. Because of the shortage of space, cross sections for some, but not for all, transitions between different azimuthal quantum numbers are given. Marked disagreement with some of the data of previous authors is found. Some of the results obtained can also be used with moderate accuracy for bound–bound transitions in hydrogen-like ions. (auth)

Atomic Theory

Refer also to abstract 8685.

8356 MODULATED EXPONENTIAL DECAY IN A TWO-LEVEL QUANTUM SYSTEM. Keller, O. A.; Robiscoe, R. T. (Univ. of Michigan, Ann Arbor). Phys. Rev.; 188: 82-90 (5 Dec 1969).

A Weisskopf–Wigner-type calculation is carried out for a system of two quantum levels simultaneously coupled by a quantized radiation interaction H and a classical external perturbation V. The results for the level populations properly reduce to the quantum oscillation solution when $H \rightarrow 0$. When neither H nor V is zero, the upper level undergoes a modulated exponential decay. An ex-

pression for the perturbed decay rate is derived and a new type of modulation factor is discovered. The result suggests possibly important modifications to the standard phenomenological solution of the three-level H + V problem, which is of practical interest. (auth)

Cosmic Radiation

Refer also to abstracts 7629, 8298, 8553, and 8561.

8357 (AECL-3453) COSMIC RAY MT-64 MUON MONITOR DATA. III. SOLAR ROTATION 1826 TO ROTATION 1839 (January 6, 1967 to January 18, 1968). Steljes, J. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Oct 1969. 95p. Dep. CFSTI (U. S. Sales Only). AECL $2.00.

Hourly rates corrected for atmospheric temperature and pressure from four cosmic-ray stations in Canada that have muon monitors maintained by AECL, and from a survey monitor stationed at Kula, Hawaii, are given in tabular form by solar rotation for the period from the beginning of Rotation 1826 to the end of Rotation 1839 (January 6, 1967 to January 18, 1968). The Dorman–Maeda temperature correction factors for each station calculated at 12-hour intervals from the radiosonde data of the Canadian Meteorological Branch or the U.S. Weather Bureau are also listed. Barometric pressures are available from neutron monitor data reports already published. Graphs of the relative hourly rates at each station are given. (auth)

8358 (AECL-3454) COSMIC RAY NM-64 NEUTRON MONITOR DATA. XIII. Monthly Graphs, May 1969–August 1969. Steljes, J. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Sep 1969. 66p. Dep. CFSTI (U. S. Sales Only). AECL $1.50.

Uncorrected and barometer-corrected results from the cosmic-ray stations in Canada using equipment maintained by AECL are given in tabular form for the period from May to August 1969. Normalized graphs are given for the same period. (auth)

8359 (N-69-39175) AN ATLAS OF 10 TO 50 keV SOLAR FLARE X RAYS OBSERVED BY THE OGO SATELLITES, JANUARY 1–DECEMBER 31, 1967. Kane, S. R.; Winckler, J. R. (Minnesota Univ., Minneapolis. School of Physics and Astronomy). Apr 1969. Contract NAS5-2071. 92p. (NASA-CR-106092; CR-134). CFSTI.

This atlas represents the summation of solar x-ray events recorded during 1967 by the large ionization chambers on the OGO-1 and OGO-3 satellites. The details of the instrumentation, the response of the ion chambers, and typical samples of space data are presented. Since the ionization chambers are sensitive to all types of radiation, the x-ray increases will often be accompanied by solar particle events, by transitory increases near the radiation belts associated with magnetospheric electrons, and always by a background of galactic cosmic rays. Microwave radio emission of duration is indicated by a horizontal line on the figure, with maxima indicated by vertical arrows with the frequency indicated. A similar code indexes any associated short-wave fadeouts (SWF). (auth) (STAR)

8360 (N-69-39268) ANISOTROPIC SOLAR COSMIC RAY PROPAGATION IN AN INHOMOGENEOUS MEDIUM. PART 2. Burlaga, L. F. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Aug 1969. 26p. (NASA-TM-X-63698). CFSTI.

A model for anisotropic solar cosmic-ray propagation gives two coupled, partial differential equations for the intensity and anisotropy of solar cosmic rays propagating with finite speed V in an inhomogeneous medium. The model is used to study the effect of the solar shell on solar cosmic-ray propagation. It predicts an exponential decay, regardless of the observer's position. Model predictions when the observer is near the center of the shell, $t_D/t_o \approx 20$ to 30, (t_D = decay time, t_o = onset time) and $A_m \approx 15\%$, of $t_m/t_o \approx 3$ to 5 (t_m = time of maximum), are consistent with observations of relativistic particles on Feb. 23, 1956. When the observer is between the shell and the Sun, the model predicts that oscillations might be observed near maximum intensity. When the observer moves away from the Sun and the shell, the propagation is diffusive, but there is an increasingly large persistent anisotropy which serves as a measure of the width of the shell. (auth) (STAR)

8361 CHERENKOV LIGHT IN EXTENSIVE AIR SHOWERS AND THE CHEMICAL COMPOSITION OF PRIMARY COSMIC RAYS AT 10^{16} eV. Krieger, Allen S.; Bradt, Hale V. (Massachusetts Inst. of Tech., Cambridge). Contracts F-44-620-67-C-0020; AT(30-1)2098. Phys. Rev.; 185: 1629-35(25 Sep 1969).

An array of nine atmospheric Čerenkov light (CL) detectors was operated on Mt. Chacaltaya, Bolivia (altitude 5200 m) in conjunction with the Bolivian Air Shower Joint Experiment (BASJE). Data were obtained during the periods July to November 1966 and June to November 1967. CL detectors were located at radii of 15, 150, and 300 m from the center of the BASJE particle-detector array. Each CL detector consisted of nine 5-in.-diam photomultipliers with a total sensitive area of 880 cm^2 and an acceptance cone of 65° (full width at half-maximum) about the vertical. The minimum detectable CL pulse, in the presence of background starlight, was less than 10^4 photons/m^2. For showers in the size interval $10^6 < N < 10^8$ particles, the CL intensities ρ (r,N) in the radial region r = 25–300 m are fitted fairly well by the function $\rho(r,N) = kN^{0.7\ 0.1} \exp(-\alpha r + \beta r^2)$, where $\alpha = 1.8 \times 10^{-2}$ m^{-1}, $\beta = 1.3 \times 10^{-3}$ m^{-2}, and k = 155 ± 80 (visible photons) m^{-2}. The distribution of CL intensity (normalized to constant size and radius) indicates that the primary cosmic-ray beam at 10^{16} eV is probably mixed in chemical composition, much as it is at 10^{12} eV. (auth)

8362 PLASMA INSTABILITIES OF STREAMING COSMIC RAYS. Tademaru, E. (Univ. of Chicago). Astrophys. J.; 158: 959-79(Dec 1969).

A general expression is derived for the growth rate, due to particle–wave resonance, of plasma waves propagating in a spatially homogeneous, but anisotropic, relativistic plasma embedded in a uniform ambient magnetic field. This expression is good for plasma waves of arbitrary polarizations, wave vectors, and frequencies, provided that the growth rate is much less than the real part of the wave frequency. Applying this expression to an idealized model of cosmic rays streaming parallel to the magnetic field in a cold background plasma the system is found to be unstable against waves propagating at an arbitrary angle θ to the field direction, provided that the phase velocity of the waves is less than the streaming velocity times the cosine of θ. If the streaming velocity is greater than the Alfvén velocity, then the maximum growth rate occurs at frequencies much less than the cyclotron frequency of the cold ions. These low-frequency instabilities persist over a wide range of propagation angles since the growth rates vary only slowly with angle. These instabilities have e-folding times very much shorter than the lifetime of the cosmic rays in the galactic disk. An estimate of the time for the waves to gain a significant part of the bulk-streaming energy of the cosmic rays is obtained from the second-order equations. It is argued that the main effect of the waves is to reduce the mean streaming velocity by redistribution of momentum pitch angles with little transfer of energy. (auth)

8363 SURVEY OF POSSIBLE SOURCES OF COSMIC GAMMA RAYS ABOVE 50 MeV IN THE NORTHERN HEMISPHERE. Frye, Glenn M. Jr.; Wang, Chia Ping (Case Western Reserve Univ., Cleveland). Contracts AT(11-1)-818; NASA 9-4411. Astrophys. J.; 158: 925-37(Dec 1969).

In a search for cosmic γ radiation above 50 MeV, 60% of the northern hemisphere has been surveyed on four balloon flights at 2.5 mbar. Gamma rays were detected by the electron–positron pairs produced in the plates of a 30-gap spark chamber which is sensitive from 50 MeV to 2 GeV and has an angular resolution of 2.6 and an HWHM acceptance angle of 20°. Nonscattering single tracks are shown to be unresolved pairs. No point sources of γ rays were seen in the regions $270° < \alpha < 135°$, $7° < \delta < 57°$; $125° < \alpha < 220°$, $-12° < \delta < 37°$. Upper limits to a number of possible point sources, such as the Crab Nebula, Cygnus A, Cyg XR-1, M87, 3C 48; 3C 273, CP 1133, CP 1919, and the Sun, were set in the ranges $E_\gamma > 50$ MeV, $(1-4) \times 10^{-5}$ γ's cm^{-2} sec^{-1}; $E_\gamma > 150$ MeV, $(1-2) \times 10^{-5}$ γ's cm^{-2} sec^{-1}; and $E_\gamma > 500$ MeV, $(0.5-1.5) \times 10^{-5}$ γ's cm^{-2} sec^{-1}. For the Crab these results imply an average magnetic field of $>4 \times 10^{-5}$ gauss and no direct production of synchrotron electrons from high-energy p–p collisions. The limit for M87 is an order of magnitude below Felten's curve which fits from 10^8 to 10^{19} Hz. The main energy source for 3C 273 cannot be matter–antimatter annihilation. The intensity from the galactic plane $-3° < b^{II} < 3°$, $55° < l^{II} < 85°$ exceeds neighboring areas in the ratio 1.2 ± 0.1, a value which confirms the OSO-3 results, although no excess is seen in the direction of the galactic anticenter, an observation in disagreement with the satellite observation. The intensity of the atmospheric γ rays is proportional to the depth of the residual atmosphere above 35 km and, when extrapolated to the top of the atmosphere, yields an upper limit to the isotropic intensity of cosmic γ rays of 0.5×10^{-3} γ's cm^{-2} sec^{-1} $sterad^{-1}$. (auth)

8364 COSMIC RAY INTERACTIONS IN PARAFFIN AND LEAD. Mundra, J. P.; Bhattacharyya, D. P.; Senchaudhury, P. K. (Presidency Coll., Calcutta). Z. Naturforsch.; 24a: 1541-3(Oct 1969).

Nuclear interactions of cosmic rays under paraffin and lead

were studied by means of a counter-controlled multiplate cloud chamber. The lead plates inside the chamber served as producer and analyzer. A search was made for the possible transition effect of nuclear interaction in lighter elements using charged components for triggering and to compare it with a previously observed apparent transition effect in graphite for neutron showers, using coincidence neutron counters. The results show a continuous increase of nuclear interaction with increasing thickness of paraffin absorber up to 30.4 g cm^{-2}. A similar rise is also observed under 11.3 g cm^{-2} of Pb. (auth)

8365 DIFFUSION CALCULATIONS AND SOLAR PROTON SPECTRA. Lichtenstein, Pearl R. (Rensselaer Polytechnic Inst., Troy, N. Y.). pp 184-9 of In Honor of Philip M. Morse. /Feshbach, Herman; Ingard, K. Uno (eds.). Cambridge, Mass.; Massachusetts Institute of Technology Press (1969).

It is demonstrated that neglect of the spectral energy distribution of solar protons can lead to serious discrepancies between observed and predicted diffusion results, for even the simplest models. These discrepancies are most marked at low energies and when the sensitivity range of the detector exceeds a few MeV. Before more complicated models are adopted, therefore, allowance must be made for the effects of the proton spectrum. When such corrections are included, improved values of solar burst and diffusion parameters are obtained. (auth)

8366 RADIOACTIVITY INDUCED BY COSMIC RAYS OF GALACTIC AND SOLAR ORIGIN IN BODIES OF THE SOLAR SYSTEM. Lavrukhina, A. K. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1783-9(Nov. 1968). (In Russian).

Distribution of nuclear-active particles and radioisotopes in meteorites of various size and compositions was analyzed. Models were constructed for determining the rate of accumulation of cosmogenic isotopes at various points of meteoritic bodies. Trajectories of heavy cosmic-ray nuclei in meteorites and products of nuclear reactions induced by cosmic rays on the surface of large bodies were analyzed and interpreted. Data on the magnitude of the $^{22}Na/^{26}Al$ ratio in meteorites that fell during the last solar cycle were considered in order to determine the influence of the solar wind on the intensity of galactic cosmic rays. Tabulated data showed that in all recently fallen stone meteorites, except Harleton, the ratio was constant although the intensity of cosmic rays at the Earth's atmospheric boundary, during their drop, changed 4 times ($E_p > 8.4$ MeV). It was concluded that, at the distance of 3 to 5 au from the Sun, the 11-year intensity variations of galactic cosmic rays are considerably smaller than at the Earth's atmospheric boundary. (R.V.J.)

8367 ANALYSIS OF COSMIC RAY VARIATIONS AS A METHOD FOR STUDYING INTERPLANETARY MEDIA. Dorman, L. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1770-5(Nov. 1968). (In Russian).

Data on cosmic-ray variations were analyzed for use in studying interplanetary media. Propagation of solar cosmic rays and measurements of the radial and transverse gradients of cosmic-ray intensity in interplanetary space and reviewed, as well as meteorite data on distribution of cosmic rays in interplanetary space, relative dimensions and magnetic structure of the solar wind, and nuclear composition of primary low-energy cosmic rays. 25 references. (R.V.J.)

8368 A COMPARISON OF THE ENERGY SPECTRA OF COSMIC RAY HELIUM AND HEAVY NUCLEI. Von Rosenvinge, T. T. (Univ. of Minnesota, Minneapolis); Webber, W. R.; Ormes, J. F. Astrophys. Space Sci.; 5: 342-59(Nov 1969).

Recent observations of the spectra of cosmic-ray helium, M, LH, and VH nuclei in the energy range from $\lesssim$200 MeV/n to >22 GeV/n are reported. The differential spectra of all of these groups of nuclei are found to have a maximum at 300 to 400 MeV/n at sunspot minimum. The average exponents on the integral rigidity spectra in the range 5 to 50 GV are 1.54 ± 0.03 for He nuclei, 1.50 ± 0.04 for M nuclei, 1.47 ± 0.06 for LH nuclei, and 1.40 ± 0.08 for VH nuclei. The spectra of these groups of nuclei are compared and it is found that the average He/M, He/LH, and He/VH ratios are 16 ± 1, 70 ± 3, and 200 ± 15, respectively. These values are reasonably constant from the highest down to the lowest energies measured although some evidence for a "dip" is present in the 500 to 1000 MeV/n range for both the He/LH and He/VH ratios. Solar modulation effects on these ratios are discussed and it is concluded that the ratios measured at Earth are representative of those existing in interstellar space only if energy-loss processes in interplanetary space are unimportant. The influence of interstellar propagation on the spectra and charge ratios at low energies arising from ionization energy loss and nuclear spallation during matter traversal is examined. It is found that propagation models that contain a large number of relatively short path lengths significantly modify the expected effects of ionization energy loss at low energies. Specifically it is suggested that the presently measured charge ratios are consistent with the passage of the average cosmic radiation through enough matter to reproduce the abundances of the so-called fragmentation nuclei, Li, Be, B, and ^3He. Two component models are not required to explain the data. Rather it is felt that a better representation of the situation results from considering a continuous spatial distribution of sources which, along with the actual interstellar propagation conditions, leads to a particular distribution of matter path lengths. It is pointed out that large differences exist in the approaches used in the literature to calculate the effects of matter traversal in interstellar space at low energies. These differences play an important role in the interpretation of the experimental results. Significant modifications of the charge ratios at low energies can also be obtained by requiring that some of the matter traversal occur in the cosmic-ray sources themselves during the cosmic-ray acceleration process. This may be sufficient to produce charge ratios that are essentially flat at low energies even in the presence of interstellar ionization loss. (auth)

Direct Energy Conversion

Refer also to abstracts 7594 and 7595.

8369 (LA-4215) THERMAL ANALYSIS OF A THERMIONIC DIODE. Sutherland, C. D. (Los Alamos Scientific Lab., N. Mex.). 9 Jul 1969. Contract W-7405-eng-36. 16p. Dep. CFSTI.

A mathematical model is described which was used to determine the performance of a cylindrical thermionic diode. Experimentally determined current-voltage characteristics at constant cesium pressure are used to determine emission-current density as a function of emitter temperature and voltage. Numerical solutions of the system of first-order differential equations comprising the model have been used to determine optimum electrical power output and efficiency for a single thermionic diode as a function of emitter length. Results are also given for the optimum performance of a thermionic fuel rod containing series-connected thermionic diodes in which there is an axial variation of thermal power density. (auth)

8370 (N-69-37703) REVIEW OF LIQUID-METAL MAGNETOHYDRODYNAMIC ENERGY CONVERSION CYCLES. Morse, Frederick H. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Aug 1969. 53p. (NASA-TM-X-63671; X-716-69-365). CFSTI.

Interest in liquid-metal magnetohydrodynamic (LM-MHD) power generation has developed because of its high power density, its ability to operate both ac and dc generators, and the possibility of operation at moderate temperatures. Recent efforts and advances in LM-MHD have made the evaluation of such systems for spacecraft power supply feasible. All of the reported LM-MHD power generation cycles are described and their efficiencies compared. A brief summary of the evolution and status of the LM-MHD power generation systems and a listing of facilities engaged in LM-MHD is also included. (auth) (STAR)

8371 (N-69-37883) EFFECT OF ELECTROTHERMAL INSTABILITIES ON BRAYTON- AND RANKINE-CYCLE MAGNETOHYDRODYNAMIC SPACE-POWER GENERATION SYSTEMS. Bishop, Allan R.; Nichols, Lester D. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Oct 1969. 18p. (NASA-TN-D-5461). CFSTI.

Plane wave electrothermal instabilities are included in the analysis of idealized Brayton- and Rankine-cycle magnetohydrodynamic generators. It is shown that the instabilities cause an increase in Joule heating and a reduction in output power. An increase in the magnetic field can compensate for the reduction in output power. (auth) (STAR)

8372 OPEN-CYCLE MHD POWER GENERATION. RESULTS OF RESEARCH CARRIED OUT BY MEMBERS OF THE BRITISH MHD COLLABORATIVE COMMITTEE. Heywood, J. B.; Womack, G. J. (eds.). New York; Pergamon Press (1969). 806p.

Detailed results are presented for the following: (1) directly fired air heaters, (2) separately fired air heaters, (3) combustion, (4) duct physics, (5) MHD test facilities and diagnostics, (6) electrodes and insulators, (7) magnets, (8) seed recovery and chemistry, (9) steam plant equipment, and (10) cycle analysis and appraisal. (M.O.W.)

8373 ELECTRODYNAMIC PROPERTIES OF THE INDUCTION MHD GENERATOR, WORKING WITH QUASISTATIONARY

SLIP. Hrynczuk, J. (Inst. of Fluid Flow Machines, Danzig). [Pr.] Inst. Masz. Przeply.; 39: 107-21(1968). (In Polish).

The substitutional scheme of an induction MHD generator was constructed and its impedance represented in the form of a chain fraction. A remarkable simplification of the analysis and of considerations concerning the generator's electrodynamic properties was thus brought about. A physical interpretation of the scheme is given and the generator working conditions are discussed. Some characteristics of the generator, e.g., output and power factor cos φ, were determined as functions of the slip and the ratio of duct height 2a to length λ. Some possibilities of optimization are indicated. (auth) (NSA of Poland)

8374 MAGNETOGASDYNAMIC THRUST BEARING WITH AN AXIAL PINCH. Ramanaiah, G. (Indian Inst. of Tech., Kharagpur). J. Fluid Mech.; 38: 673-7(6 Oct 1969).

An analysis of a hydrostatic thrust bearing with electrically conducting compressible lubricant under an axial-current-induced pinch is presented. It is shown that the load capacity of the bearing can be increased by the pinch effect and the magnitude of the pinch effect depends on the mass flow rate. It is also shown that a load proportional to the square of the axial current can be sustained even when there is no flow or external pressurization. (auth) (UK)

Fluid Physics

8375 (N-69-11471) ELECTROHYDRODYNAMIC RAYLEIGH-TAYLOR BULK INSTABILITY. Turnbull, Robert J.; Melcher, James R. (Massachusetts Inst. of Tech., Cambridge. Center for Space Research). 1 Nov 1968. 26p. (NASA-CR-97784; CSR-TR-68-11). CFSTI.

A stability criterion is found for an initially static, stratified fluid subject to an electric stress. The equilibrium fluid density, permittivity, viscosity, and space charge distributions are functions of the vertical spatial coordinate, with gradients directed parallel with the imposed electric field intensity and gravitational acceleration. In the limit where the fluid is perfectly insulating, sufficient conditions for stability are found; the principle of exchange of stabilities is shown, and variational principles derived for the eigenfrequencies and, in the case of no space charge, for the critical field strength. An experiment demonstrates instability in the dielectrophoretic limit of no bulk free charge. The property gradients are induced thermally, and incipience of instability, as measured by the Schmidt-Milverton heat transfer technique, is successfully predicted by the theoretical criterion. (auth) (STAR)

8376 HALL EFFECTS ON HEAT TRANSFER IN MHD CHANNEL FLOW UNDER CROSSED FIELDS. Soundalgekar, V. M. (Indian Inst. of Tech., Bombay). Proc. Nat. Inst. Sci. India, Part A; 35: 492-501(Jul 1969).

The combined influence of tensor conductivity, magnetic field, and electric field on heat transfer in a channel with segmented electrodes was investigated. A solution for temperature and Nusselt number was obtained in a closed form based upon an incompressible, two-dimensional flow with constant properties. Calculations presented here show the influence of $\omega_0\tau$ (product of electron cyclotron frequency and electron mean free time), M (Hartmann number), K (loading parameter) and PrReS (product of Prandtl number, Reynolds number and a non-dimensional number) on the temperature field. It is found that an increase in $\omega_0\tau$ leads to an increase in fluid temperature and the Nusselt number, but an increase in PrReS leads to a decrease in fluid temperature. In the case of the channel when working as a MHD generator, an increase in K leads to a decrease in the fluid temperature θ. Also Nusselt number increases with $\omega_0\tau$ as well as K. (auth)

8377 MAGNETOHYDRODYNAMIC FLOW BETWEEN TWO PARALLEL PLATES, ONE IN UNIFORM MOTION AND THE OTHER AT REST WITH UNIFORM SUCTION AT THE STATIONARY PLATE. Verma, P. D.; Mathur, A. K. (Univ. of Rajasthan, Jaipur, India). Proc. Nat. Inst. Sci. India, Part A; 35: 507-17 (Jul 1969).

Hydromagnetic Couette-type flow with small uniform suction at the stationary plate is considered. The basic equations are solved by reducing them to second- and third-order nonlinear differential equations under appropriate boundary conditions. The longitudinal and transverse velocity profiles for $\lambda = 0.1$, $R = 100$ and different values of M are drawn. It is noted that at a distance, depending on the Hartmann number, an adverse pressure gradient develops that causes a back flow. The pressure increase in the main flow direction decreases with the increase of Hartmann number. The coefficient of skin friction decreases with the increase of suction parameter or with the increase of Hartmann number. (auth)

8378 INVESTIGATION OF A STEADY MAGNETOHYDRODYNAMIC SHEAR LAYER USING HOT-FILM ANEMOMETRY. Malcolm, D. G. (Univ. of Saskatchewan, Saskatoon). Nature (London); 224: 909-10(29 Nov 1969).

It is stated that theoretical studies of MHD flows in ducts and around bodies of revolution have predicted the occurrence of intense shear layers in these systems and a detailed investigation of velocity profiles in such a shear layer is described, using a miniature quartz-insulated cylindrical hot film sensor in the constant-temperature mode in mercury. Such a device shows much promise as a velocity indicator in electrically conducted media. The experimental results showed moderate qualitative agreement with the theory of Hunt and Stewartson (J. Fluid Mech. 38: 225(1969)), but the quantitative agreement was not good. Firm evidence of secondary flow was found in the apparatus tested. This implied that greater spatial resolution and smaller measurement errors due to MHD effects inherent in the sensor make it a more useful local velocity measuring device than its alternatives. Experimental details are given, and the measured stable velocity profiles are shown graphically. (UK)

8379 OSCILLATING FLOW OF CONDUCTING FLUIDS IN PIPES UNDER UNIFORM TRANSVERSE MAGNETIC FIELDS. 2. PLANE-PARALLEL PERFECT CONDUCTING WALLS. Ohki, Morimatsu (Yamagata Univ., Yonezawa, Japan). Yamagata Daigaku Kiyo, Kogaku; 10: 485-510(Mar 1969). (In Japanese).

The oscillatory flow of an incompressible conducting viscous fluid through a channel with perfect electric conductivity in a uniform transverse magnetic field is analyzed under magnetohydrodynamic approximations. It is assumed that the pressure gradient is harmonically oscillating, and that the velocity and the induced fields have the same forms as the pressure gradient depends on time. Then the generalized solutions containing the limiting cases of the oscillating flow of viscous fluids, and of the steady flow of conducting fluids through the channel with perfect conductivity are obtained. Numerical calculations given by the relations of velocity, Poiseuille number, and induced fields with Hartmann number, the oscillatory Reynolds number, and wall conductivity are discussed. Magnetohydrodynamic effects in which the inverse of Poiseuille number decreases, whenever the Hartmann number is increased, are more remarkable in the case of perfect conducting walls than in the case of the insulating ones. When the Hartmann number is small, the amplitude of the velocity has two definate maxima near the walls, but when the Hartmann number is large, it becomes flat, i.e., the annular effects of Richardson and Tyler are decreased by magnetohydrodynamic interaction. The shifting phase is always smaller in the perfectly conducting channel than in the insulating one. When a certain electrically conducting fluid is oscillated through a channel with perfect conductivity, it is accelerated as by an electromagnetic pump. In this phenomenon it is pointed out that magnetic Prandtl number is as important as Hartmann number and oscillatory Reynolds number in choosing such a fluid. (NSA of Japan)

8380 ON THE SPINUP OF AN ELECTRICALLY CONDUCTING FLUID. PART 1. THE UNSTEADY HYDROMAGNETIC EKMAN-HARTMANN BOUNDARY-LAYER PROBLEM. Benton, Edward R. (Univ. of Colorado, Boulder); Loper, David E. J. Fluid Mech.; 39: 561-86(Nov 1969).

The prototype spin-up problem between infinite flat plates treated by Greenspan & Howard (J. Fluid. Mech., 17: 385-404 (1963)) is extended to include the presence of an imposed axial magnetic field. The fluid is homogeneous, viscous, and electrically conducting. The resulting boundary initial-value problem is solved to first order in Rossby number by Laplace transform techniques. In spite of the linearization, the complete hydromagnetic interaction is preserved: currents affect the flow and the flow simultaneously distorts the field. The impulsively started time dependent approach to a final steady Ekman-Hartmann boundary layer on a single insulating flat plate is analysed. The transient is found to consist of two diffusively growing boundary layers, inertial oscillations, and a weak Alfvén wave front. (auth) (UK)

8381 ELECTROHYDRODYNAMIC ION SOURCE. Mahoney, John F.; Yahiku, Arthur Y.; Daley, Howard L.; Moore, R. David; Perel, Julius (Electro-Optical Systems, Pasadena, Calif.). J. Appl. Phys.; 40: 5101-6(Dec 1969).

An electrohydrodynamic (EHD) technique is used to generate ions from liquid metals. Liquid metal is fed to the tip of a capillary needle emitter with a voltage difference applied between the emitter and an extractor electrode to produce an intense field at the liquid surface. Electrostatic forces overcome surface tension forces to produce ions by field emission. When using liquid cesium, time-of-flight mass analysis showed the ion current to be

primarily Cs^+ with a small percentage of Cs_2^+ and Cs_3^+. Electron currents of over 1 mA have been produced by operating the emitter at 2 kV negative. Besides cesium, alkali ion beams have been generated using NaK/cesium alloy and sodium. Calculations show that liquid metals of low work functions appear more suitable for production of atomic ions while higher work functions metals may produce multiatomic ions and charged droplets in addition to atomic ions. (auth)

8382 RESISTIVE FORCE-FREE MAGNETIC FIELDS. Jette, A. David; Sreenivasan, S. Ranga (Univ. of Calgary, Alberta). Phys. Fluids: 12: 2544-7(Dec 1969).

The properties of the function α characterizing force-free fields through the relation $\nabla \times B = \alpha B$ are studied, and it is shown that it has to be either a function of space and time or a constant independent of both. An initial integrability condition for α and B is found. Using this condition, it is demonstrated for cylindrically symmetric magnetic fields that α must be a constant. (auth)

8383 EXPERIMENTS ON HARTMANN CHANNEL FLOW IN PLASMAS. Sonju, Otto K.; Kruger, Charles H. (Stanford Univ., Calif.). Phys. Fluids: 12: 2548-52(Dec 1969).

An experimental study of subsonic Hartmann channel flow of a plasma is described. A partially ionized gas, consisting of high-temperature atmospheric-pressure potassium-seeded combustion products, was passed through an insulated rectangular channel in the presence of a transverse magnetic field. The influence of the electrical-conductivity profile within the plasma was studied by systematically varying the wall temperature with respect to the mean plasma temperature. The effect of the magnetic field was found to be sensitive to this temperature difference. Only situations where the wall temperature is less than the mean plasma temperature have been investigated. With wall temperatures several hundred degrees below the mean plasma temperature, an increase in wall-shear stress of about 30% is observed, as compared with a factor-of-2 increase found in the corresponding uniform conductivity, liquid metal experiments. The experimental data for laminar flow agree well with the results of an approximate analysis. Turbulence-damping effects, Hall-parameter effects and fluid-property-variation effects are discussed. The turbulence-damping effect is smaller in the present experiments than in the mercury-flow experiments. No pressure gradients were observed in the $u \times B$ direction. A complete correlation of the data is proposed. (auth)

8384 MAGNETOHYDRODYNAMIC CHANNEL FLOW. Gold, Richard R. (Hughes Aircraft Co., El Segundo, Calif.). Progr. Aeronaut. Sci., 8: 353-417(1967).

Theoretical studies were made of pipe flow of an electrically conducting viscous fluid with a transverse magnetic field. Various pipe cross-section shapes are considered. Both fully developed and entry flow are considered. A discussion of the Hall effect is also included. A valuable feature is the inclusion of 65 references to current literature. (Applied Mech. Rev.)

Geophysics (Upper Atmosphere)

8385 (AD-686113) NIGHT AIRGLOW O I GREEN CONTINUUM AND HYDROXYL EMISSIONS. Report No. Scientific-5. Waddoups, Ray O.; Baker, Doran J. (Utah State Univ., Logan. Electro-Dynamics Labs.). 1 Jun 1968. Contract AF19(628)-5916. 110p. (AFCRL-68-330). CFSTI.

Three rocketborne measurements of night airglow emissions are reported. Maximum OI green emission of 14 R/km was observed at 102 km. Maximum continuum emission of 0.04/RA/km was observed at 91 km, and maximum OH (8,3) emission of 44 R/km was observed at 97 km. Simultaneous measurement of high-energy electron flux and OI-green emission showed that no significant amount of excitation resulted from high-energy electron bombardment. These emission measurements, together with similar measurements reported by other investigators, were analyzed to determine the excitation mechanisms responsible for the emissions. (auth) (USGRDR)

8386 (AD-693560) ENERGY DEPENDENCE OF THE AVERAGE HIGH-LATITUDE CUTOFF OF TRAPPED ELECTRONS. Report for October 1968–March 1969. Davie, R. N.; Vampola, A. L. (Aerospace Corp., El Segundo, Calif.). 8 Aug 1969. Contract F04701-69-C-0066. 16p. (TR-66(5260-20)-5; SAMSO-TR-69-226). CFSTI.

The energy-dependence of the average high-latitude cutoff of trapped electrons during the period August 1966 to September 1967 was determined on the basis of data obtained from the magnetic spectrometer onboard polar satellite OV3-3 (1966-70A). The cutoff latitude decreases as the energy increases between 300 keV to 2.0 MeV. The cutoffs are compared with a theoretical calculation of Taylor, and with the magnetospheric models of Williams and Mead, and Taylor and Hones. (auth) (USGRDR)

8387 (BNWL-1156) PROGRESS REPORT ON AERONOMY RESEARCH AT RICHLAND, WASHINGTON, JULY 1969. Hoch, R. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1969. Contract AT(45-1)-1830. 94p. Dep. CFSTI.

Topics reported on include recent appearances of stable auroral red arcs, spectrographic monitoring of auroral activity at mid-latitudes, spectrographic studies, photometric map of the Milky Way, forbidden transitions, nightglow, the F-region ionosphere, automation of aeronomy equipment, and special equipment and facilities development. (W.D.M.)

8388 (N-69-37380) INVESTIGATIONS OF THE SPECTRUM OF PROTONS IN THE INNER RADIATION BELT WITH THE AID OF AES KOSMOS-137. Savenko, I. A.; (and others). Translated from Kosm. Issled.; 7: 553-8(1969). 11p. (NASA-CR-105827). CFSTI.

The results of investigations are communicated of the spectrum of protons in the inner radiation belt with the aid of AES KOSMOS-137 on shells with L = 1.2 to 1.7, alongside with the spatial distribution of protons in the energy range 0.8 – 1000 MeV and in the plane of the geomagnetic equator. Comparison is made of the results obtained with those of other authors. (auth) (STAR)

8389 (N-69-37576) SUMMARY OF PARTICLE POPULATIONS IN THE MAGNETOSPHERE. Vette, James I. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Sep 1969. 26p. (NASA-TM-X-63673; X-601-69-373). CFSTI.

The main emphasis in this summary description is on the time-averaged behavior rather than the detailed dynamical changes which occur. The magnetosphere is discussed as three separate regions: plasma sheet, pseudo-trapping, and stable trapping. The plasma sheet extends across the tail of the magnetosphere and contains electrons and protons with an average energy of 0.6 and 5 keV, respectively. The average outer boundary of the pseudo-trapping region is around 12 R_E. This region is spatially coincident with the auroral zone and represents an acceleration region where electrons are increased in energy to ≈100 keV. In an average radial profile, particle fluxes in this region are seen only as a continuation of the radiation belts; however, the shorter-term time variations seen on individual satellite passes are quite distinctive. The low-altitude boundary mapped on the equatorial plane by using the average magnetic field configuration presented by Fairfield agrees well with the boundary obtained in the equatorial plane except in the dawn–midnight quadrant. This difference may lead to an explanation of the dawn–dusk electron asymmetry seen at 17 to 18 R_E. The stable trapping boundary exists at 8 R_E. (auth) (STAR)

8390 (N-69-37680) STATIONARY WAVES PRODUCED BY THE EARTH'S BOW SHOCK. Perez, J. K.; Northrop, T. G. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Aug 1969. 36p. (NASA-TM-X-63670; X-640-69-356). CFSTI.

Stationary cyclotron waves attached to the bow shock are produced by the current in the shock. Waves upstream from the shock are circularly polarized electron waves, the polarization being in the sense of a right-hand screw when the interplanetary field is directed toward the shock, and left-hand when directed away. The downstream wave field has two components, one from the electron cyclotron branch and one from the ion cyclotron branch of the dispersion relation. The latter has a longer wavelength and a larger amplitude than the electron wave. It is elliptically polarized rather than circularly, and always in the opposite sense to the upstream electron wave. When the ambient magnetic field is not perpendicular to the shock, there also exists a stationary electrostatic wave with its electric field normal to the shock. Both up and downstream the ratio of the electrostatic wave to the magnetic wave amplitudes is of the order $u/c \tan \theta$, where θ is the angle between the normal to the shock and the magnetic field, and u is the plasma flow velocity. (auth) (STAR)

8391 THE CORRELATION OF THE CRITICAL FREQUENCY f_0F2 BETWEEN A PAIR OF MID-LATITUDE MAGNETICALLY CONJUGATE POINTS. Hooper, A. W. (Univ. of Sheffield, Eng.). J. Atmos. Terrest. Phys.; 31: 1373-81(Dec 1969).

Correlation functions were evaluated from hourly values of f_0F2 for Campbell Island and three Alaskan stations and examined for evidence of conjugate point coupling. Only a very weak coupling was found; it was much weaker than the coupling between two northern stations 2000 km apart. It is stressed that had correlation coefficients been calculated only for zero time shift, then, in many cases, the coefficients would have been interpreted in

correctly due to the presence of long-period variations in the data which could mask the instantaneous variations. (auth) (UK)

8392 LATITUDE VARIATION OF THE EFFECT OF MAGNETIC ACTIVITY ON IONOSPHERIC DRIFTS. Rao, G. L. (Brown Engineering Co., Inc., Huntsville, Ala.). Nature (London); 224: 894(29 Nov 1969).

The object of this communication is to describe variation in drift speeds with latitude under active magnetic conditions. The data employed for horizontal drifts were those available from World Data Centers for the IGY period, and the drift stations were selected to represent a selected range of latitude. The drift speeds and the corresponding K index are tabulated for all the drift recording stations and corresponding nearest magnetic observatories; the tabulated values were averaged and the average drift speed values for each corresponding K index are shown graphically. The drift speed in the E region was found to increase with magnetic activity at all stations, and more rapidly at higher K index values. An interesting variation in the values of F2-region drift speeds with latitude during magnetic activity was observed; the negative correlation of drift speed with K index at low latitudes changed gradually to a positive correlation at high latitudes, the reversal occurring at about 30° geomagnetic latitude. Other studies of the morphology of the F region during storms are briefly reviewed. In the present investigation a decrease in drift speed was observed with a corresponding increase in electron density at low latitudes in magnetically active conditions; an increase in electron density leads to increased ion drag, opposing movements, and hence the drift speed shows a negative correlation with electron density. At high latitudes in active magnetic conditions, a decrease in electron density is observed. The ion drag opposing movements is low at high latitudes and, consequently, the drift speed increases and is positively correlated with K index. Global wind speeds are also considered. (UK)

8393 SODIUM DISTRIBUTION IN THE TERRESTRIAL UPPER ATMOSPHERE. Moffett, R. J. (Univ. of Sheffield, Eng.). Nature (London); 224: 1097(13 Dec 1969).

Observations of the twilight flow and dayglow have shown that there is a thin layer of free Na atoms at a height of about 90 km, and that there is normally a daytime enhancement of the Na abundance compared with that at twilight; the daytime layer appears to be at the same height or a few km higher than the twilight layer. The scale heights on the topside (and the bottomside) of the daytime layer are unexpectedly small, ranging from 2.5 to 4.5 km, whereas the atmospheric scale height is about 6 km. These abbreviations have led to the suggestion that the chemical theory alone is not adequate, and it has been suggested that an explanation of the small scale height is to be found on the topside of the layer. In a steady-state situation, upward transport of neutral Na by eddy diffusion balances the loss at height altitudes due to photoionization, and there is a corresponding downward flux of Na ions to the region of high recombination rate. It is shown by solution of the steady-state continuity and momentum equations for Na atoms and ions, that the small negative scale height on the bottomside of the layer is a consequence of dust or meteoritic material, together with downward transport of Na to the oxidation region. (UK)

8394 DRIFT MIRROR INSTABILITY IN THE MAGNETOSPHERE. Hasegawa, Akira (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Fluids; 12: 2642-50(Dec 1969).

A new theory of the mirror instability is developed which includes the effects of ∇B and ∇n, finite Larmor radius, and a coexisting cold plasma. It is shown that the instability becomes over-stable with a frequency equal to the drift wave frequency, which may be determined by the wave-number that gives the maximum growth rate. The theory is applied to explain the sudden kink in the increase (decrease) of proton flux (magnetic field) and the subsequent oscillations observed during a storm time on 18 April 1965 by detectors on the Explorer 26 satellite. (auth)

8395 RAPID CHANGES IN THE FOURIER SPECTRA OF Pi1 PULSATIONS DURING MAGNETICALLY DISTURBED PERIODS. PART II. AMPLITUDE ANALYSIS. Prikner, Karel (Geophysical Inst., Prague). Stud. Geophys. Geod.; 13: 444-56 (1969).

Some of the substantial properties of the Pi1 pulsations that follow from the amplitude analysis of the spectra obtained are considered. This is executed with a view to the division of the included frequency range into the main resonance groups. The pulsations were analyzed, as far as possible, in all three components of the variations of the geomagnetic field X, Y, and Z, separately for each component and intervals A and B. (W.D.M.)

Low-Temperature Physics

Refer also to abstracts 7571, 8118, and 8119.

8396 INFLUENCE OF METAL COATING ON THE SUPERCONDUCTING PROPERTIES OF THIN CYLINDERS. Takacs, S. (Electrotechnical Inst., Bratislava). Czech. J. Phys.; 19: 1366-78(1969). (In German).

The critical parameters (upper critical field, critical temperature) of thin type-II superconducting cylinders are considerably changed by coating with normal metal. Below a minimum cylinder radius, the superconductivity can no longer exist. The oscillations of the critical temperature with magnetic field are also modified. For good conductive metals, only an aperiodic effect appears. The decrease of the critical temperature produced by coating is given. The relation of "thin-film quantization" to the existence of jumps in the field dependence of the critical temperature is discussed. (auth)

8397 VARIATIONAL CALCULATION OF THE PROPERTIES OF LIQUID ^{3}He–^{4}He MIXTURES AT 0°K. Hansen, Jean-Pierre; Schiff, Daniel (Univ. de Paris, Orsay, France). Phys. Rev. Lett.; 23: 1488-91(29 Dec 1969).

The properties of liquid ^{3}He–^{4}He mixtures at 0°K are studied by a variational method using a Jastrow–Slater trial wave function and the Wu–Feenberg expansion of the energy expectation value: The system of mass-3 boson + mass-4 boson shows complete phase separation; the system of mass-3 fermion + mass-4 boson and the system of mass-3 boson + mass-4 fermion mixtures separate incompletely; and the system of mass-3 fermion + mass-4 fermion mixes completely. The limiting solubility of the mass-3 fermion in the mass-4 boson solvent is found to increase with pressure. (auth)

8398 QUANTUM SIZE EFFECT IN SUPERCONDUCTING TIN FILMS. Komnik, Yu. F.; Bukhshtab, E. I.; Mankovskii, K. K. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz.; 57: 1495-1505(Nov 1969). (In Russian).

The dependences of the critical superconducting transition temperature and energy gap on thickness of tin films obtained by sputtering in vacuum are investigated. The energy gap was measured by the tunnel technique. The dependences are of an oscillational nature which is the result of quantization of the quasiparticle energy spectrum. Two types of oscillations with periods ~7.5 and ~15 Å are observed. The fermi momenta corresponding to such oscillation periods are respectively 4.4×10^{-20} and 2.2×10^{-20} g·cm/sec. (auth)

8399 SUPERCONDUCTING INTERFEROMETER WITH RESISTIVE POINT CONTACTS. Dmitrenko, I. M.; Bondarenko, S. I.; Narbut, T. P. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz.; 57: 1513-23(Nov 1969). (In Russian).

Formulas describing the main characteristics of a superconducting interferometer with two point contacts are derived on basis of the theory of the Josephson effect. A comparison is made with the experimental data obtained by investigating interferometers with point contacts of the S–S (superconductor–superconductor) and S–N–S (superconductor–normal metal–superconductor) types. A physical model of resistivity of a contact and the conditions of maximal sensitivity of the interferometer to an external magnetic field are discussed. (auth)

8400 INFLUENCE OF CRYSTAL DEFECTS ON THE CRITICAL SUPERCONDUCTIVITY TRANSITION TEMPERATURE. Maksimov, E. G. (Inst. of Physics of High Pressures, Moscow). Zh. Eksp. Teor. Fiz.; 57: 1660-72(Nov 1969). (In Russian).

The superconductivity equation for an imperfect crystal is obtained on basis of the complete electron–ion hamiltonian. It is shown that the critical temperature T_c for a superconductor of this type can be expressed by means of the correlation scattering function $S(q,\omega)$ previously employed for calculating the resistance of a normal metal. The change in T_c due to impurities and disordering is calculated. The relation between changes in T_c and changes in the linear resistivity coefficient of a metal at high temperature is established. (auth)

8401 HALL ANGLE OF DIRTY TYPE-II SUPERCONDUCTOR. Muto, Y.; Noto, K.; Hongo, M.; Mori, K. (Tohoku Univ., Sendai). Phys. Lett.; 30A: 480-1(15 Dec 1969).

The Hall angle of a dirty type-II superconductor, Nb–20 at. % Mo, was measured in the liquid helium temperature range. It increases with decreasing field from the value in the normal state at H_{c2} and attains a constant value of $\phi(0) = (2.8 \pm 0.2) \times 10^{-3}$ when extrapolated to zero field. The slope of the Hall angle just below H_{c2}, $(d\phi/dH)_{H_{c2}}$, increases rapidly with temperature. The

results were analyzed in terms of the revised theory of Maki and were found to be in good agreement with it. (M.H.R.)

8402 IMPROVED FARADAY TECHNIQUE FOR OBSERVING MAGNETIC STRUCTURES IN SUPERCONDUCTORS. Kirchner, H. (Forschungslaboratorium, Munich). Phys. Lett.: 30A: 437-8(15 Dec 1969).

Small angles of rotation in thin magneto-optic films can be enhanced by using light interference. This may allow a magneto-optical observation of low-field magnetic structures, especially of single flux lines in the mixed state of type-II superconductors. (auth)

8403 RELATIVE MOLAR VOLUME AND LIMITING SOLUBILITY OF ^{3}He IN SUPERFLUID ^{4}He. Abraham, B. M. (Argonne National Lab., Ill.); Brandt, O. G.; Eckstein, Y.; Munarin, J. Phys. Rev.; 188: 309-14(5 Dec 1969).

The relative fractional molar volume α of ^{3}He in a ^{3}He–^{4}He solution was determined by a capacitance-measurement technique with a solution which remained in a single phase down to the lowest temperature of measurement, 31.7 mK. The observed temperature dependence at saturated vapor pressure is in excellent agreement with theory. Accounting for ^{3}He kinetic and interaction effects, it is deduced that α_0, the fractional molar volume of ^{3}He at zero (concentration, temperature, and pressure) is 0.286 ± 0.001. Measurements on more concentrated solutions permitted redetermination of the limiting solubility at zero temperature, with the result $\chi_0 = 0.0660 \pm 0.0006$. (auth)

8404 CRITICAL PARAMETERS OF THIN DIFFUSION Nb_3Sn LAYERS. Polak, M. (Electrochemical Inst., Bratislava). Czech. J. Phys.; 19: 1359-65(1969).

Measurements of the critical temperature T_c and the upper critical magnetic field H_{c2} near T_c of thin diffusion Nb_3Sn layers formed on a niobium core are presented. These parameters are dependent on the Nb_3Sn layer thickness, if it decreases to values comparable with the London penetration depth. With decreasing layer thickness the critical temperature decreases and both the width of the transition curve and the upper critical field increase. H_{c2} for the thinnest investigated layers (≈1950 Å) is about 50% higher than that of the bulk materials. (auth)

8405 ROTON–PHONON RELAXATION TIMES IN HELIUM II. Donnelly, R. J.; Roberts, P. H. (Univ. of Oregon, Eugene). Phys. Lett.: 30A: 468-9(15 Dec 1969).

The conversion of rotons to phonons in helium II is considered as a diffusion process, rather than a phonon-assisted collision process. (auth)

8406 ON THE MOTION OF A SPHERE IN A PERFECT FLUID, WITH APPLICATION TO LIQUID HELIUM. Rice, O. K. (Univ. of North Carolina, Chapel Hill). Proc. Nat. Acad. Sci. U. S.; 63: 1055-62(Aug 1969).

Momentum relationships involved in the motion of a sphere through a perfect fluid are considered. The mechanism, by which the momentum given to a sphere by an external impulsive force is transferred to the container as a whole, is traced through in some detail, and energy and momentum relationships are discussed. Comparison is made with a ^{3}He atom or a roton moving in superfluid ^{4}He. (auth)

8407 TEMPERATURE DEPENDENCE OF THE JOSEPHSON CURRENT IN ANISOTROPIC SUPERCONDUCTORS WITH NONMAGNETIC IMPURITIES. Golub, A. A. pp 6-10 of Issledovaniya po Kvantovoi Teorii Sistem Mnogikh Chastits. Moskalenko, V. A. Kishinev, USSR, Inst. of Mathematics and Computer Center, 1969. (In Russian).

The temperature and impurity dependences of Josephson currents in slightly anisotropic superconductors were studied. Limited cases of large and small concentrations of nonmagnetic impurities were examined. (tr-auth)

8408 EFFECT OF PARAMAGNETIC IMPURITIES IN SUPERCONDUCTORS WITH CURRENT. Kolpashiu, M. K.; Moskalenko, V. A. pp 25-36 of Issledovaniya po Kvantovoi Teorii Sistem Mnogikh Chastits. Moskalenko, V. A. Kishinev, USSR, Inst. of Mathematics and Computer Center, 1969. (In Russian).

The effect of paramagnetic impurities on the current states of single-zone isotropic superconductors was studied. At zero temperature the effect of paramagnetic impurities on the ordering parameter of the current states of the superconductor was studied; the critical concentration of paramagnetic impurities for which superconductivity disappears in the presence of current turns out to be less than in its absence. The magnitude of the electric current in relation to the impurity concentration was calculated. The magnitude of the energy gap and the density of states in this area were studied. (tr-auth)

8409 THERMODYNAMICS OF TWO-ZONE SUPERCONDUCTORS. THE CASE OF HIGH PARAMAGNETIC IMPURITY CONCENTRATION. Kon, L. Z. pp 36-8 of Issledovaniya po Kvantovoi Teorii Sistem Mnogikh Chastits. Moskalenko, V. A. Kishinev, USSR, Inst. of Mathematics and Computer Center, 1969. (In Russian).

The effect of large concentrations of paramagnetic impurities on the thermal properties of superconductors in the two-zone model was studied. Equations for the critical impurity concentration at which the gapless superconducting state develop were derived. The densities-of-states of the electrons of each zone were calculated, and from these low-temperature electronic specific heats were obtained. In gapless regions low-temperature heat capacity is equal to the sum of normal electronic heat capacities of each zone but, in addition to that, the densities-of-states of the electrons were renormalized because of the scattering of electrons on impurity atoms. (tr-auth)

8410 THERMODYNAMICS OF TWO-ZONE ANISOTROPIC SUPERCONDUCTORS. Kon, L. Z. pp 38-45 of Issledovaniya po Kvantovoi Teorii Sistem Mnogikh Chastits. Moskalenko, V. A. Kishinev, USSR, Inst. of Mathematics and Computer Center, 1969. (In Russian).

The system of integral equations for energy gaps in a two-zone anisotropic superconductor was investigated. Indications were that the inequalities of V. L. Pokrouskogo remain in effect in the two-zone anisotropic case. Inequalities were established between the corresponding magnitudes in two-zone isotropic and two-zone anisotropic models. These inequalities are analogous to the corresponding inequalities of V. L. Pokrouskogo. (tr-auth)

8411 LOCALIZATION OF SPINS IN TWO-ZONE SUPERCONDUCTOR. Marinchuk, M. E.; Moskalenko, V. A. pp 45-8 of Issledovaniya po Kvantovoi Teorii Sistem Mnogikh Chastits. Moskalenko, V. A. Kishinev, USSR, Inst. of Mathematics and Computer Center, 1969. (In Russian).

In two-zone superconductors it is shown that if the impurity level is within the most narrow energy gap in the spectrum of elementary excitations, then it is stationary. In the other cases, the lifetime of this state of atom impurity is determined by additive contributions of those zones, and the impurity exists outside the energy gaps. Results obtained are similar to formulas for normal metals, except that the densities-of-states for normal metals near the Fermi level are replaced by the corresponding magnitudes for multiple-zone superconductors. (tr-auth)

8412 PROCEEDINGS OF THE Xth INTERNATIONAL CONFERENCE ON LOW TEMPERATURE PHYSICS, MOSCOW, USSR, AUGUST 31–SEPTEMBER 6, 1966. VOLUME II A. SUPERCONDUCTIVITY. Malkov, M. P. (ed.). Moscow; All-Union Scientific-Research Institute of Technology (1967). 496p. (In Russian and English). (CONF-660816-(Vol.2A)).

This volume consists of 91 papers (11 of which are of abstract or summary length) that cover various aspects of superconductivity, both experimental and theoretical. Fourteen of the papers are in Russian (4 summaries) and the remainder (77) in English (7 summaries). The first six papers included are invited papers. (L.M.T.)

8413 CALCULATION OF THE COULOMB INTERACTION IN IMPURE SUPERCONDUCTORS. Palistrant, M. E. pp 48-55 of Issledovaniya po Kvantovoi Teorii Sistem Mnogikh Chastits. Moskalenko, V. A. Kishinev, USSR, Inst. of Mathematics and Computer Center, 1969. (In Russian).

From the Bardeen–Pines Hamiltonian generalized for the two-zone model of a superconductor, an expression was obtained at T_c for superconductors with impurities. Calculation of the Coulomb interaction between electrons leads to the replacement of parameter V_{ij} from the theory of two-zone superconductors (Zh. Eksp. Teoret. Fiz., 49: 770(1965)) by magnitudes Γ_{ij}, which are by generalization of the two-zone model, the parameter of the effective interaction in multi-zone models (Morel and Anderson, Phys. Rev., 125: 1263(1962) and Moskalenko (Fiz. Tverd. Tela., 4: 2770(1962)). (tr-auth)

8414 DETERMINATION OF THE UPPER CRITICAL FIELD H_{c2} IN TWO-ZONE SUPERCONDUCTORS. Palistrant, M. E.; Dedyu, V. I. pp 55-64 of Issledovaniya po Kvantovoi Teorii Sistem Mnogikh Chastits. Moskalenko, V. A. Kishinev, USSR, Inst. of Mathematics and Computer Center, 1969. (In Russian).

Pure type-II two-zone superconductors are considered at arbitrary temperatures in the vicinity of the upper critical field H_{c2}. An expression for the magnitude of $H_{c2}(T)$ in the region of high and low temperatures was obtained. This expression (in contrast to multi-zone superconductors) contains definite combinations of constants of the intrazone and interzone couplings for interactions of electrons. (tr-auth)

8415 HARTREE MODELS OF THE SUPERFLUID HELIUM FILM. Hyman, D. S. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett.: 30A: 466-7(15 Dec 1969).

Phenomenological models of the superfluid helium film are discussed. It is shown that a recent Hartree model due to Gross and Amit cannot lead to a completely realistic description of such films. (auth)

8416 THERMODYNAMICS OF TYPE-I AND TYPE-II SUPERCONDUCTORS. Hake, R. R. (North American Rockwell Corp., Thousand Oaks, Calif.). J. Appl. Phys.: 40: 5148-60(Dec 1969).

After a brief description of the basic characteristics of type-I and type-II superconductors, a unified classical thermodynamic treatment is outlined. Some applications of thermodynamic formulas to type-II behavior are then discussed, closing with a consideration of upper-critical-field limits and fluctuation superconductivity in bulk extreme-type-II superconductors. (auth)

8417 PLASTIC DEFORMATION AND SUPERCONDUCTIVITY IN LEAD, INDIUM, AND THALLIUM. Schenck, J. F.; Shaw, R. W. (Rensselaer Polytechnic Inst., Troy, N. Y.). J. Appl. Phys.: 40: 5165-70(Dec 1969).

Experimental results are presented for wire specimens of high-purity lead, indium, and thallium which have been plastically deformed at liquid-helium temperatures and subsequently annealed. The deformation is found to broaden the magnetic transition to the normal state in lead but not in indium or thallium. It is proposed that, for the deformed lead samples in fields larger than the bulk critical field, the superconductivity is confined to small filaments with high defect concentrations. These filaments are restricted to the surface of lightly deformed samples but exist throughout the bulk of heavily deformed samples. It is suggested that the Mendelssohn sponge model is a natural consequence of the Ginzburg–Landau theory for those inhomogeneous, type I superconductors which, when homogeneous, have large kappa values. Significant recovery of the strain-induced resistivity increment is observed below liquid-nitrogen temperatures for all three metals; at higher temperatures a pronounced recrystallization step is observed in lead but not in indium and thallium. Dislocation-induced deviations from Kohler's rule were observed in the magnetoresistivity of lead. (auth)

8418 NMR RELAXATION TIMES MEASUREMENTS OF PROTONS IN SUPERCONDUCTING POWDERS. Ehrenfreund, E.; Goldberg, I. B.; Weger, M. (Hebrew Univ., Jerusalem). Solid State Commun., 7: 1333-6(Sept. 15, 1969).

T_1 measurements in a superconducting hydrated V–Ti alloy indicate that the main contribution to the proton relaxation rate comes from a "purely" magnetic process. A probable source for this process is a thermal fluctuation of the fluxoids or, less plausible, magnetic impurities. (auth) (UK)

8419 NUCLEAR ALIGNMENT IN A KONDO SYSTEM AS A VERY LOW TEMPERATURE THERMOMETER. Pratt, W. P. Jr.; Schermer, R. I.; Steyert, W. A. (Los Alamos Scientific Lab., N. Mex.). J. Low Temp. Phys.: 1: 469-76(Oct 1969).

Copper doped with less than 1 ppM ^{54}Mn appears to offer a number of advantages as a γ-ray anisotropy thermometer in the temperature range 1 to 20 mK. In order to use such a thermometer it is necessary to know how the hyperfine field at the ^{54}Mn nuclei varies with temperature and with applied field. This γ-ray anisotropy was studied and it was found that the hyperfine field is independent of temperature in the range 4 mK < T < 10 mK. Further, the hyperfine field was determined to ±5% as a function of applied field in the range 60 Oe < H_a < 1200 Oe. The latter data may be used to determine a Kondo temperature of 64 ± 2 mK for this system. (auth)

8420 SUPERCONDUCTING PROPERTIES OF NIOBIUM-TITANIUM NITRIDE THIN FILMS. Gavaler, J. R.; Deis, D. W.; Hulm, J. K.; Jones, C. K. (Westinghouse Research Labs., Pittsburgh). Appl. Phys. Lett.: 15: 329-31(15 Nov 1969).

A series of Nb–Ti–N films were prepared, with various Nb/Ti ratios, by a high-purity, reactive sputtering process. A maximum in transition temperature (at ~15.5°K) was obtained for a composition of $Nb_{0.5}Ti_{0.5}N$. Critical field and critical current measurements indicate a degradation in these properties with increasing titanium content, contrary to results reported previously. (auth)

8421 HYDRODYNAMICS AND THIRD SOUND IN THIN He II FILMS. Bergman, D. (Univ. of California, San Diego, La Jolla). Phys. Rev.; 188: 370-84(5 Dec 1969).

The linearized hydrodynamic equations of motion for a thin, flat, superfluid helium film are derived in some detail from standard two-fluid hydrodynamics. Interactions of the film with both the He vapor and the substrate which are in contact with it are included and discussed in detail. Boundary conditions for both the film-substrate and film-gas interfaces are derived. It is indicated how one may construct the equations of motion for the entire coupled system (gas-film substrate). The equations are actually constructed and solved for the case when a certain parameter is small, which includes all the third-sound experiments on unsaturated films. A dispersion equation is found which is exact in the limit of vanishing frequency, and which is eminently suited to describe both the velocity and the attenuation of third sound in the regime of unsaturated films. No hydrodynamic instability is found. Results for the attenuation are shown to be in good agreement with preliminary experiments on unsaturated He films. (auth)

8422 MOTION OF DISLOCATIONS IN THE VORTEX LATTICE OF A SUPERCONDUCTOR. Brandt, E. H. (Max-Planck-Institut fuer Metallforschung, Stuttgart. Univ., Stuttgart). Phys. Status Solidi: 36: K167-70(1 Dec 1969).

The motion of the dislocations is treated theoretically. The results are applied in the case of a Pb–In alloy giving the dislocation velocity u = 730 cm/sec. (M.H.R.)

8423 THEORETICAL CALCULATIONS ON DEFECTS IN THE FLUX LINE LATTICE. Hill, D. C.; Morrison, D. D.; Rose, R. M. (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys.: 40: 5160-4(Dec 1969).

Computer-aided variational calculations were made to examine the stability of various lattice defects in the flux line lattice which exist in the mixed state of type-II superconductors. The stable configurations agreed with the direct experimental observations of Essmann and Träuble, if the dislocations and vacancies were assumed to be associated with pinning centers. The presence of pinning centers can also explain the frequencies with which the various defects are observed. The Peierls potential for dislocations was also calculated, as well as the theoretical shear stress for the perfect lattice. (auth)

Plasma and Thermonuclear Physics

8424 [PLASMA PHYSICS]. pp 359-604 of Ninth International Conference on Phenomena in Ionized Gases, 1969, Bucharest, Romania, September 1–6, 1969. /Musa, Geavit; Ghica, Ion; Popescu, Alexandrina; Nastase, Ligia (eds.). Bucharest; Editura Academiei Republicii Socialiste Romania (1969).

See CONF-690803.

Two-hundred forty-six papers include studies on the following: (1) distribution functions and statistical mechanics, (2) microfields and Vlasov equation, (3) equilibrium and confinement problems, (4) hydrodynamics and magnetoplasmadynamics, (5) general transport equations, (6) transport coefficients, (7) electrical and thermal conductivity, (8) normal, ambipolar, and anomalous diffusion, (9) general theory of plasma waves, (10) waves in cylindrical columns, (11) ionization waves, (12) damping and propagation of various waves, (13) plasma waves, echoes, and whistlers, (14) drift waves, (15) acoustic waves and ion-acoustic waves, (16) cyclotron waves and cyclotron and hybrid resonance, (17) nonlinear effects, linear and nonlinear transformations, (18) interaction of electromagnetic waves with plasma and anomalous heating, (19) general theory of beam–plasma waves and synthesized plasmas, (20) hf fields and nonlinear effects in beam–plasma systems, (21) instabilities, turbulence, and miscellaneous nonlinear effects, (22) continuum radiation, (23) broadening and shift of spectral lines, (24) line emission, and (25) miscellaneous studies of spectra and radiation. (M.O.W.)

8425 [SURFACE PHENOMENA]. pp 76-125 of Ninth International Conference on Phenomena in Ionized Gases, 1969, Bucharest, Romania, September 1–6, 1969. /Musa, Geavit; Ghica, Ion; Popescu, Alexandrina; Nastase, Ligia (eds.). Bucharest; Editura Academiei Republicii Socialiste Romania (1969).

See CONF-690803.

Fifty papers are presented on the following general subjects: (1) thermionic and secondary emission, (2) work function and field emission, (3) sputtering, secondary emission, and radiation damage, (4) scattering and quantum effects, and (5) interaction of plasma with surfaces. (M.O.W.)

8426 NINTH INTERNATIONAL CONFERENCE ON PHENOMENA IN IONIZED GASES, 1969, BUCHAREST, ROMANIA, SEPTEMBER 1–6, 1969. Contributed Papers. Musa, Geavit; Ghica, Ion; Popescu, Alexandrina; Nastase, Ligia (eds.). Bucharest; Editura Academiei Republicii Socialiste Romania (1969). 736p. (CONF-690803).

Separate abstracts were prepared for the five separate sections. (M.O.W.)

For abstracts of individual sections see: 8424, 8425, 8444, 8452, and 8453.

Confinement and Heating

8427 (MATT-706) EFFECT OF NEUTRAL PARTICLES AND SUPPORTS ON THE CONFINEMENT OF PLASMAS IN THE SPHERATOR. Yoshikawa, S.; Freeman, R.; Okabayashi, M. (Princeton Univ., N. J. Plasma Physics Lab.). Nov 1969. Contract AT(30-1)-1238. 20p. (CONF-691105-1). Dep. CFSTI.
From 11th Annual Meeting of the Division of Plasma Physics, Los Angeles, Calif.

A model is proposed to explain the neutral-pressure dependence of the confinement time observed in the spherator. The theory predicts that the existence of supports causes a density variation on the magnetic surfaces, and the resulting electric field gives an anomalous diffusion across the magnetic field. The theoretical values are both qualitatively and quantitatively in agreement with the experimental values, for several different gases. (auth)

8428 (ORO-3778-2) THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF HARMONIC ION CYCLOTRON WAVE PROPAGATION AND PLASMA HEATING. Progress Report No. 2. Kristiansen, M.; Hagler, M. O.; Cato, J. E. (Texas Tech Univ., Lubbock. Plasma Lab.). 15 Nov 1969. Contract AT(40-1)-3778. 44p. Dep. CFSTI.

An experimental arrangement for the investigation of plasma heating by wave damping near harmonics of the ion cyclotron frequency is described. The waves are excited by coupling pulsed rf energy into a Stix coil, and the waves are damped in a magnetic beach. Both hydrogen and deuterium plasmas are investigated. The plasma is confined in a magnetic mirror configuration with a 1.5 mirror ratio and a maximum flux density of 0.6 Tesla in the Stix coil region. The maximum pulsed rf power level for wave excitation is 170 kW. A pulsed dc discharge employing a hot cathode is used for preionization. Diagnostic techniques include electric and magnetic probes, diamagnetic probes, microwave interferometry, spectroscopy, and others. Further theoretical studies of the harmonic ion cyclotron waves are discussed and some of the approximations made in the quasi-static ion cyclotron wave theory evaluated. The plasma heating scheme proposed earlier utilizing the damping of fast (or right) waves near the second harmonic of the ion cyclotron frequency is discussed further. A new rf coupling scheme may be needed since the harmonic wave excitation with the Stix coil at high plasma densities ($\sim 10^{19} m^{-3}$) has not been successful so far. (auth)

8429 (UCRL-71721) PLASMA CONFINEMENT IN HYBRID MULTIPOLE-STELLARATOR FIELDS. Hartman, Charles W.; Munger, Richard H.; Uman, Myron F. (California Univ., Livermore. Lawrence Radiation Lab.). 25 Nov 1969. 17p. (CONF-690931-1). Dep. CFSTI.
From International Sympsoium on Confinement Systems, Dubna, USSR.

Confinement measurements were made of noble gas plasmas (helium, argon, xenon) produced by microwave heating in stellarator or hybrid multipole-stellarator confining fields. The results are described in two broad topics, general confinement properties, and possible loss mechanisms. (M.O.W.)

8430 PLASMAS. Grad, Harold. Contract AT-(30-1)-1480. Phys. Today; 22: No. 12, 34-44(Dec 1969).

Plasma research carried out throughout the world is briefly described. The different programs and some typical data from each are given. Problems related to plasma research are also discussed. (M.O.W.)

8431 RADIAL DIFFUSION OF CHARGED PARTICLES IN A HIGH FREQUENCY DISCHARGE IN A MAGNETIC FIELD. Wagner, S. D.; Krylov, N. A.; Shlyaev, B. V. Zh. Eksp. Teor. Fiz.; 57: 1543-50(Nov 1969). (In Russian).

The effect of an axial magnetic field on radial diffusion of charged particles is investigated. The experimental diffusion coefficients are compared with those calculated on basis of diffusion theory and also with the results of the theory of ion-acoustic oscillations. (auth)

8432 DISTRIBUTION OF HOT ELECTRONS IN A PLASMA HEATED BY AN ELECTRON BEAM IN A MAGNETIC MIRROR MACHINE. Blinov, P. I.; Ivkin, M. V. Zh. Eksp. Teor. Fiz.; 57: 1561-4(Nov 1969). (In Russian).

Heating of a plasma in a magnetic mirror machine by an electron beam is studied. It is shown that the heating occurs in the central part of the trap in which the mirror ratio does not exceed 3. The temperature of the hot electrons increases linearly with the plasma radius. The electron beam loses not less than 13% of its energy in the plasma. (auth)

8433 MEASUREMENTS OF DIFFUSION IN VELOCITY SPACE FROM ION-ION COLLISIONS. Wong, A. Y.; Baker, D. R. (Univ. of California, Los Angeles). Phys. Rev.; 188: 326-40 (5 Dec 1969).

Diffusion of particles in velocity space due to ion-ion collisions is measured experimentally using the spatial ion-wave echo as a diagnostic technique. The experiment was performed in a highly ionized plasma. The ion-ion collisions are described by a Fokker-Planck term in the ion kinetic equation. The good agreement between the measurement of the echo position, phase velocity, and amplitude with the theoretical predictions verifies that the diffusion term of the Fokker-Planck equation is appropriate for describing the effect of small-angle Coulomb collisions. The magnitude of the second-order coupling coefficient relating the amplitudes of the excited waves to the echo amplitude was also measured. The agreement with theory indicates the validity of the second-order expansion of the linearized Vlasov equation. (auth)

8434 LASER-INDUCED ANOMALOUS HEATING OF A PLASMA. Kaw, P. K.; Dawson, J. M. (Princeton Univ., N. J.). Phys. Fluids: 12: 2586-91(Dec 1969).

It is shown that a sufficiently intense laser beam can drive low-frequency instabilities in a fully ionized plasma; these instabilities may cause considerable enhancement of the high-frequency resistivity of the plasma around certain frequencies and thus lead to an anomalous heating effect. (auth)

8435 EXPERIMENTS ON THE INJECTION AND CONTAINMENT OF ELECTRON CLOUDS IN A TOROIDAL APPARATUS. Daugherty, J. D.; Eninger, J. E.; Janes, G. S. (Avco Everett Research Lab., Everett, Mass.). Phys. Fluids: 12: 2677-93 (Dec 1969).

Injection and containment of unneutralized clouds of electrons has been accomplished with an azimuthally symmetric, toroidal, magnetic field. The confining magnetic field is produced within a conducting toroidal chamber. The induction of this magnetic field has been used to inject the electron cloud (inductive charging). Average electron densities of 4×10^9 cm^{-3} and peak electrostatic well depths of ≈400 kV have been achieved. Semiempirical correlations are given which show the inductive charging scheme to be governed by an electron energy restriction and finally limited by the occurrence of anomalous crossed field beam noise. Stable equilibria, without the necessity of a rotational transform have been observed for times in excess of 60 μsec. Correlation of the containment time observations with the predictions of a theoretical model for an ion-diocotron wave instability shows that the containment time is governed by the rate of ionization of the residual neutral gas ($p > 10^{-7}$ torr) in the apparatus. The correlation of theory and experiment appear to confirm the theoretical prediction that a significant degree of charge neutralization (in the range of 10 to 20%) can be stably contained. Interpretation of these results suggests that significant improvement in both electron cloud density and containment time should be possible. (auth)

Diagnostics

8436 (AEC-tr-7114) EXTENSION OF THE RANGE OF MEASUREMENT OF PLASMA DENSITY BY MEANS OF A LASER INTERFEROMETER WITH PHASE MODULATION OF THE VISUAL SIGNAL. Dushin, L. A.; Privezentsev, V. I. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). Translation of report FTI-165. 7p. Dep. CFSTI.
An abstract of this paper, prepared from the original language, appeared as NSA 23: 36651. (M.O.W.)

8437 (N-69-38697) DIAGNOSTICS OF ACCELERATING PLASMA. Semiannual Progress Report, September 1, 1968-February 28, 1969. Lie, T. N.; McLean, E. A. (Catholic Univ. of America, Washington, D. C. Dept. of Space Science and Applied Physics). 31 May 1969. 44p. (NASA-CR-106111; SAPR-6). CFSTI.

Validity criteria for the local thermal equilibrium (LTE) assumption are applied to the T-tube plasma in order to justify results described earlier. Furthermore, the line intensities of He II 468 Å and He I 5876 Å are calculated under the assumption of LTE in order to compare the values with those obtained from the measurement. The two results indicate that the T-tube plasmas with $N_e > 10^{17}$ cm^{-3} are in approximate LTE and those with $N_e < 10^{17}$ cm^{-3} may deviate from LTE density population. Several factors which affect the velocity of the current sheet in a coaxial plasma accelerator such as the insulator ablation, the radius ratio of the electrode, the species of gas, and its pressure are

examined experimentally, and the results are compared with the theoretical predictions. (auth) (STAR)

8438 UNSTEADY EFFECTS ON LANGMUIR PROBES AT MODERATE FREQUENCIES. Berman, Charles Henry. Princeton, N. J.; Princeton Univ. (1969). 127p.

Thesis.

A theoretical investigation of the interaction of electrostatic plasma waves with a solid surface is used to determine the nature of the response of electrodes in time dependent operation. The analysis examines the propagation, absorption, and reflection of ion waves and concludes that unsteady effects may play an important role at frequencies well below the ion plasma frequency, ωpi, when the Debye length is smaller than any characteristic distance. For example, although it is generally believed that quasi-steady Langmuir probe theories of current collection remain valid at frequencies below ωpi, the present analysis finds that the probe admittance is increased markedly for a range of frequencies below ωpi, but above a certain frequency dependent on the plasma properties and the probe dimensions and voltage bias. The question concerning the reflection or absorption of waves incident on a surface is found to be dependent upon the wave's frequency, the plasma's properties, and the probe's dimensions, voltage bias, and circuitry. A cutoff in the radiation of acoustic power produced by a probe undergoing forced voltage oscillations is found at frequencies below ωpi. The linearized analysis identifies four distinct oscillatory modes, two corresponding to long-wavelength ion–acoustic waves while the other two are short-wavelength non-quasineutral modes. The behavior of these waves in a critical layer adjacent to the probe's sheath is studied in detail for the case of a highly negative spherical probe, whose radius is much larger than a Debye length, immersed in a uniform, nonflowing, cold ion plasma. The study of a transonic phenomenon near the sheath edge demonstrates the importance of the non-quasi-neutral effects of charge separation for the description of even acoustic-like waves. The solutions obtained within the sheath lead to the determination of the probe's frequency-dependent current–voltage relation under various conditions. (Diss. Abstr.)

8439 ANOMALOUS CURRENTS TO A SPHERICAL ELECTROSTATIC PROBE IN A FLAME PLASMA. Clements, R. M. (Univ. of Victoria, British Columbia); Smy, P. R. J. Phys., D (London); 2: 1731-8(Dec 1969).

By following the same line of reasoning which was used in a previous paper (1969), concerned with cylindrical probes, the ion current I_i to a spherical probe (radius r_p, bias voltage V) immersed in a collision-dominated flowing plasma of subsonic velocity v_f was calculated to be $I_i = (Vr_p)^{0.8}(n_e v_f)^{0.6}\pi(6\epsilon_0\mu_i e^{1.5})^{0.1}/(1 - 1.28r_p(\pi n_e e v_f / I_i)^{0.5})^{0.8}$ where n_e is the electron density, μ_i the ion mobility, e the electronic charge, and ϵ_0 the permittivity of free space. This theory is only valid for conditions where the plasma sheath diameter $r_0 \gg r_p$. A propane–air flame with a moving probe was used to investigate the above relationship. Reasonable agreement (considering the approximations made in deriving the theoretical relationship) was obtained between measured and theoretical ion currents. (auth) (UK)

8440 DETERMINING THE ELECTRON DENSITY OF A CYLINDRICAL PLASMA COLUMN BY LONGITUDINAL RESONANCES OF SURFACE WAVES. Stojcev, T.; Zeljazkov, Iv.; Nikolov, N. God. Sofii. Univ., Fiz. Fak.; 61: 85-92(1966–67 Publ. 1968). (In Russian).

A simple method is described for determining the electron number density of a cold plasma column based on longitudinal resonances of axially symmetric waves on the plasma surface. It is used for excitation and detection of the surface waves; a Q meter with frequency range 100 to 300 MHz. It is possible to calculate the mean electron number density $\langle n_e \rangle$. The experimental results obtained by this method are in good agreement with the data of the mean electron number density measured by microwave cavity perturbation method. (auth) (Abstr. Bulg. Sci. Lit.)

8441 TIME-RESOLVED MEASUREMENTS OF ELECTRON ENERGY DISTRIBUTIONS. Rayment, S. W.; Twiddy, N. D. (Univ. of York, Eng.). J. Phys., D (London); 2: 1747-54(Dec 1969).

A new sampling technique was developed that enables time-resolved electron energy distribution measurements to be made in a periodically varying plasma by means of the Langmuir–Druyvesteyn probe method. The method is illustrated with measurements made in moving striations in a neon discharge (p = 0.32 torr, I = 330 mA, 2R = 7.0 cm); the validity of the technique for these discharge conditions is examined in detail. (auth) (UK)

8442 INVESTIGATION OF THE POSITIVE COLUMN OF NEON DISCHARGES AT AVERAGE GAS PRESSURES. III. Golubovskii, Yu. B.; Kagan, Yu. M.; Michel, P.; Nesterova, L. L. (Univ., Leningrad). Beitr. Plasmaphys.; 9: 217-25(1969). (In German).

Electron concentrations in the positive column of neon discharges are calculated on a theoretical basis and are experimentally tested with double probe measurements. With increasing gas pressure, the experimental results are about ten times higher than the theoretical values. Reasons for this deviation are discussed. (H.B.G.)

8443 DETERMINATION OF PLASMA ELECTRON DENSITY PROFILES BY MEANS OF RESONANT CAVITIES. Janzen, G. (Univ., Stuttgart). Z. Naturforsch.; 24a: 1496-1501(Oct 1969). (In German).

The shift of the resonant frequency of microwave cavities excited in TM_{0m0} (m = 1, 2, 3), TM_{110} (l = 1, 2), TE_{01n} (n > 0, integer) modes under the influence of a plasma is calculated for arbitrary radii of plasma and cavity for Bessel profile and common parabolic profiles. In measuring the frequency shift for two of the cited cavity mode types an approximate electron density profile can be determined from the submitted diagrams. (auth)

8444 [GENERAL EXPERIMENTAL TECHNIQUES]. pp 605-72 of Ninth International Conference on Phenomena in Ionized Gases, 1969, Bucharest, Romania, September 1–6, 1969. /Musa, Geavit; Ghica, Ion; Popescu, Alexandrina; Nastase, Ligia (eds.). Bucharest; Editura Academiei Republicii Socialiste Romania (1969).

See CONF-690803.

Sixty-six papers are presented on the following plasma topics: (1) probe techniques, (2) spectral line techniques, (3) laser techniques, (4) electromagnetic wave scattering, (5) microwave and rf propagation techniques, and (6) other diagnostic methods. (M.O.W.)

8445 MEASUREMENT OF A SMALL RADIUS PLASMA COLUMN WITH MICROWAVE TECHNIQUES. Narita, Hirokazu (Nara Junior Tech. Coll., Japan). Nara Kogyo Koto Senmon Gakko Kenkyu Kiyo; No. 4, 77-83(1968). (In Japanese).

Various investigations about diffusion and instability in positive column have been sought by many authors. However, for the plasma in which the mean free path of particles is larger than the radius of a discharge tube and its gas pressure is relatively high (10^{-2} to 1 torr), no report has been received up to present. The author studies such as plasma and measures its physical parameters using microwave techniques. The diagnostic technique here uses the microwave impedance method which is appropriate for plasma having relatively high density. The method mentioned above is simplified to facilitate a treatment of measuring results. A discharge tube is similar to the one developed by Singh & Rowe and is filled with argon gas. From the experimental results, it is seen that the electron density of plasma varies logarithmically with both discharge current and gas pressure, but that the collision frequency of electron holds a constant in spite of the change of discharge current. The values of experimental results show a good agreement with theoretical ones. Moreover, several interesting phenomenon are observed by experiments. (NSA of Japan)

8446 PERIODIC POTENTIAL PROBE CONFIGURATION FOR PLASMA DIAGNOSTICS. Mosburg, Earl R. Jr. (National Bureau of Standards, Boulder, Colo.). J. Appl. Phys.; 40: 5290-5307(Dec 1969).

A probe having a spacially periodic potential is created by a bifilar winding of small tungsten wire. This geometry results in an electric field configuration having an extremely short penetration distance into the plasma. When the behavior of this probe is studied in extended negative glow and back-diffusion type plasmas, the floating mode current–voltage characteristic curve is seen to be quite different from that of the usual double probe in that no effects of the electrons are observed. The behavior of the periodic probe is controlled by the ion inertia established in the diffusion region which lies just in front of the probe. The important parameter of the characteristic curve is the slope near zero applied voltage difference which can be related in a simple manner to the flux of plasma diffusing to the probe and to the diffusion drift energy of the ions as they reach the probe. The electrons make no contribution to this slope for low applied voltage differences. This probe thus provides a very sensitive method for measuring the diffusive flux of plasma to a containing wall. (auth)

8447 COLLISION FREQUENCY AND AXIAL INHOMOGENEITY EFFECTS ON AVERAGE PLASMA CONDUCTIVITY BY rf PROBES. Ciampi, M.; Talini, N. (CAMEN, Pisa, Italy). J. Appl. Phys.; 40: 5394-6(Dec 1969).

Rf probes using the impedance method are used to measure the electric conductivity of moving plasmas at high temperatures. It is shown how the measured σ_0 in an inhomogeneous plasma differs

from the volumetric average $\bar{\sigma}$, using logarithmic plots of ξ_0 vs ξ (field penetration) for resistance and inductance measurements. The effects of the collision frequency on the probe impedance for the homogeneous and inhomogeneous medium are considered. Equations are derived for the average conductivities of a plasma with a weak axial inhomogeneity when $\nu \gg \omega$. (D.L.C.)

8448 GAS-HEATING EFFECT ON PLASMA RESISTIVITY. Creedon, John E.; Schneider, Sol (Army Electronics Command, Fort Monmouth, N. J.). J. Appl. Phys.; 40: 5212-16(Dec 1969).

Measurements of hydrogen-plasma resistivity were made under conditions where the dominant loss mechanism was electron–neutral collisions. Three-inch-diameter tubes with electrode spacings ranging from 2 to 22 in. were used. Measurements were made at 15 and 22 kA, 56-μsec pulse duration, and pressures of 0.5, 1.0, and 5.0 torr. Electron-density and temperature measurements were obtained from Stark-broadening and line-intensity-ratio techniques. The predicted resistivity was calculated from electron–proton and electron–neutral collisions and compared with the absolute resistivity calculated from the voltage–current measurements. The gas temperature rise was determined from the resistance difference obtained from the two calculations. The energy expended in gas heating was determined to be 2.4 to 4.2% of the input energy. (auth)

Kinetics (General)

Refer also to abstracts 8424 and 8490.

8449 (NP–18086) AN UNFOLDING PROCEDURE FOR STARK AND DOPPLER BROADENED He II LINES. Rijnhuizen Report 69-54. de Vries, R. F. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Aug 1969. 31p. Dep. CFSTI (U. S. Sales Only).

Mechanisms that may lead to broadening of spectral lines emitted by a plasma were surveyed. Spectral line profiles are described with generalized Voigt functions; an unfolding procedure is given with the aid of these generalized Voigt functions. The functions are applied to the profile of the ionized helium line λ4686 Å. Spectral-line intensity distributions of a Fabry–Perot interferogram are analyzed. A method is developed for deriving electron densities between 10^{21} and 10^{23} m^{-3} and ion temperatures between 10^4 and 7×10^5°K from the simultaneously measured halfwidths of two strong lines of ionized helium in the visible (λ4686 Å) and near-uv region (λ3203 Å). Results of measurements on a θ pinch are given. (M.O.W.)

8450 GAS BREAKDOWN AT RADIOFREQUENCY IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD. Sen, S. N.; Bhattacherjee, B. (Univ. of North Bengal, Darjeeling, India). J. Phys., D (London); 2: 1739-46(Dec 1969).

The breakdown of a gas excited by a radiofrequency voltage of frequency 17.6 MHz was studied in a cylindrical discharge tube of length 0.3 cm and radius 1.4 cm, in hydrogen, air, oxygen and carbon dioxide, within the pressure range 1 to 6 torr and in a transverse magnetic field varying from zero to 1800 G. The experimental conditions indicate that the discharge here is diffusion controlled. The values of α/p at different E/p values, calculated from the theory of Brown (1956 and 1959) as well as from Kihara's (1952) theory, were compared with the α/p values given in the literature. It is noted that α/p values calculated from Brown's theory are in better agreement with the published results than those calculated from Kihara's theory. The change of diffusion length in the presence of a transverse magnetic field was obtained from measured E/p values, and comparison with theoretical values shows that there is quantitative agreement for small H/p, where H is the magnetic field. At higher magnetic fields the divergence is ascribed to the inadequacy of the equivalent pressure concept and also to the uncertainty in the values of the molecular constants introduced by Kihara. (auth) (UK)

8451 MASS-SPECTROMETRIC WALL-CURRENT ANALYSIS OF STATIONARY LAYERS OF POSITIVE COLUMNS OF HYDROGEN GLOW DISCHARGES. Schmidt, M. (Deutsche Akademie der Wissenschaften zu Berlin. Institut fuer Gasentladungsphysik, Greifswald, Ger.). Beitr. Plasmaphys.; 9: 227-42(1969). (In German).

Hydrogen glow discharges were studied in tubes of 3.0-cm diameter under various pressures and currents. The experimental results show two maxima of electron density. Reasons for this behavior of electrons is discussed. Mass-spectrometric determinations show a relationship of H_3^+, H^+, and H_2^+ of approximately 1000 to 100 to 1. Special concentrations of hydrogen atoms near the containing wall were investigated both theoretically and experimentally. (H.B.G.)

8452 [COLLISION PROCESSES]. pp 1-75 of Ninth International Conference on Phenomena in Ionized Gases, 1969, Bucharest, Romania, September 1–6, 1969. /Musa, Geavit; Ghica, Ion; Popescu, Alexandrina; Nastase, Ligia (eds.). Bucharest; Editura Academiei Republicii Socialiste Romania (1969).

See CONF-690803.

Seventy-five papers are presented on collision processes in swarms: (1) recombination, attachment, and ion mobilities, (2) reactions, neutral and ion–molecules, (3) afterglows, (4) ionization, excitation–deexcitation, dissociation, (5) avalanches, (6) physical chemistry of plasma, (7) ionization and relaxation in shock waves, and (8) shock waves in magnetic fields. (M.O.W.)

8453 [ELECTRICAL DISCHARGES]. pp 126-358 of Ninth International Conference on Phenomena in Ionized Gases, 1969, Bucharest, Romania, September 1–6, 1969. /Musa, Geavit; Ghica, Ion; Popescu, Alexandrina; Nastase, Ligia (eds.). Bucharest, Editura Academiei Republicii Socialiste Romania (1969).

See CONF-690803.

Two-hundred thirty-three papers from studies in low- and high-pressure discharges are included under the following topics: (1) breakdown and pulsed discharges, (2) glow discharges, (3) low-pressure arcs, (4) hollow cathodes, (5) positive columns, (6) physics of plasma diodes, (7) instabilities and volume effects, (8) discharges in various field configurations, (9) hf discharges, (10) magnetron and PIG discharges, (11) laser discharges, (12) sparks and spark breakdown, (13) corona, (14) high-pressure arcs, (15) high-current, pulsed stabilized arcs, (16) arcs and discharges in magnetic fields, (17) laser-induced discharges, (18) plasma propulsion and jets, (19) exploding wires, and (20) torches. (M.O.W.)

8454 MIXING PHENOMENA IN A HELIUM–HYDROGEN PULSED PLASMA. Hermel, Alfred (Deutsche Akademie der Wissenschaften zu Berlin). Beitr. Plasmaphys.; 9: 261-84(1969). (In German).

With spectroscopic measurements, the radial distribution of temperature and particle concentration was determined in a helium–hydrogen plasma. Helium–hydrogen mixtures of 10 to 1.5, one to two, and one to one were investigated with pulses of 70-μsec duration. Axial temperature ranged from 5×10^4 to 4.5×10^4 K, with electron densities of approximately 8×10^{16} cm^{-3}. In the axial region, as well as in the boundary regions, deviations from the original mixtures were observed. Theoretical reasons for this phenomenon are discussed. (H.B.G.)

8455 QUANTITATIVE EXPERIMENTAL AND THEORETICAL INVESTIGATIONS ON THE INTERACTION OF SHOCK WAVES WITH MAGNETIC FIELDS. Klingenberg, H.; Sardei, F.; Zimmermann, W. (Institut fuer Plasmaphysik, Garching, Ger.). Z. Naturforsch.; 24a: 1449-57(Oct 1969).

In continuation of the work on interaction between shock waves and magnetic fields, the experiments reported here measured the atomic and electron densities in the interaction region by means of an interferometric and a spectroscopic method. The transient atomic density was also calculated using a one-dimensional theory based on the work of Johnson, but modified to give an improved physical model. The experimental results were compared with the theoretical predictions. (auth)

Kinetics (Experimental)

8456 (SC-T-69-1058) INTERFEROMETRIC INVESTIGATIONS OF ELECTROMAGNETICALLY ACCELERATED SHOCK WAVES. [PART] II. Brinkschulte, H. Translated by Marcel I. Weinreich (Sandia Labs., Albuquerque, N. Mex.), from Z. Naturforsch.; 22A: 438-43(1967). 16p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 29247. (M.O.W.)

8457 ANOMALOUS DIFFUSION AND RESISTIVITY OF A TURBULENT WEAKLY IONIZED PLASMA. Garosi, G. A. (Massachusetts Inst. of Tech., Cambridge); Bekefi, G.; Schulz, Michael. Appl. Phys. Lett.; 15: 334-7(15 Nov 1969).

The plasma loss rate and certain transport coefficients of a dc discharge in the presence of turbulent argon-gas flow are found to vary strongly with Reynolds number (Re). The loss rate increases by a factor of 15 as Re is increased from zero to 6300. (auth)

8458 HIGH-TEMPERATURE VISCOSITY RATIOS FOR HYDROGEN, HELIUM, ARGON, AND NITROGEN. Guevara, F. A.; McInteer, B. B.; Wageman, W. E. (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids; 12: 2493-2505(Dec 1969).

The temperature dependency of the coefficient of viscosity relative to its value at 283°K was determined for hydrogen, helium,

argon, and nitrogen at atmospheric pressure. The method used is a variation of the usual capillary viscometry scheme in that no attempt is made to obtain absolute viscosity values. The measurements provide the ratio of the viscosity of a gas at temperature T to its viscosity at the reference temperature 283°K. The value of T ranges from 1100 to 2150°K and is measured by a disappearing filament pyrometer. In this relative method there is cancellation of most noncontrolled experimental variables so that the measurements are of high reproducibility, ±0.1%, and apparently accuracy, ±0.4%, is limited only by the uncertainties in the international temperature scale in the optical pyrometer range. These results are higher by 3 to 8% compared with the results of previous workers. However, extrapolation of lower-temperature viscosity measurements by Kestin and Leidenfrost, and more recently by DiPippo, gives excellent agreement with the values reported here. (auth)

8459 STUDY OF THE INFLUENCE OF A GRID ON THE PLASMA IN A SINGLE-ENDED Q-MACHINE. **Andersen, S. A.; Jensen, V. O.; Nielsen, P. (Atomic Energy Commission, Risoe, Denmark). Phys. Fluids: 12: 2694-2701(Dec 1969).**

The mechanism of the interaction between a biased grid and the plasma in a "single-ended" Q machine was studied experimentally. It was found that the grid reflects some of the ions in the plasma flow. The number and velocity distribution of the reflected ions depend on the bias of the grid, on the plasma density, and on the distance between the grid wires. The reflected ions move as freely streaming particles except at high densities, where binary collisions are of importance. A small sinusoidal voltage applied to the biased grid excites an upstream wave with dispersion properties that can be explained as phase mixing of freely streaming particles reflected by the grid. (auth)

Kinetics (Theoretical)

8460 (MATT-736) THERMOKINETIC EXPANSION THEORY. Dawson, John M. (Princeton Univ., N. J. Plasma Physics Lab.). Dec 1969. Contract AT(30-1)-1238. 14p. Dep. CFSTI.

The expansion of a hot plasma into a vacuum is discussed. Both spherical and nonspherical expansions are described, with emphasis on the physics. Similarity solutions are presented. The absorption of laser radiation by a nonuniform plasma is also discussed. It is found that an overdense plasma effectively absorbs laser radiation if the scale length for density falloff is greater than the distance that light travels in an electron–ion collision time. (auth)

8461 (N-69-39187) INTERIM ABSORPTION COEFFICIENTS AND OPACITIES FOR HYDROGEN PLASMA AT HIGH PRESSURE. Patch, R. W. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Oct 1969. 88p. (NASA-TM-X-1902; E-5147). CFSTI.

The spectral absorption coefficient was calculated for hydrogen for photons with wave numbers from 500 to 400,000 cm^{-1} (infrared, visible, and ultraviolet). The plasma was assumed to be in local thermodynamic equilibrium at temperatures from 3,000 to 90,000°R (1,667 to 50,000 K) and pressures from 100 to 1000 atm (1.013×10^7 to 1.013×10^8 N/m^2). Fifteen absorption processes were included. The calculation included the hydrogen triatomic molecular ion H_3^+ in the composition as well as deviations of the real index of refraction from one near the plasma wave number. Both caused significant effects on the spectral absorption coefficient. The Planck and Rosseland mean opacities were derived and calculated. (auth) (STAR)

8462 STATISTICAL MECHANICS OF THE FREE ELECTRONS IN A PARTIALLY IONIZED PLASMA. Wright, Thomas Payne. University Park, N. Mex.; New Mexico State Univ. (1969). 112p. Thesis.

Klein's theorem for the thermodynamic functions of a classical plasma satisfying the equipartition theorem is generalized to include systems that violate the equipartition theorem. The resulting form is valid for quantum as well as classical systems. It provides a powerful thermodynamic consistency check on formulas given in the literature, and puts restrictions on the analytical form of correction terms to the conventional expressions for the average kinetic energy and electrostatic energy. (TSS) (Diss. Abstr.)

8463 CALCULATION BY THE CORRELATION FUNCTION METHOD OF THE CONTRIBUTION OF INELASTIC COLLISIONS TO THE KINETIC COEFFICIENTS. **Podlubnyi, L. I. (Moscow Energetics Inst.). Zh. Eksp. Teor. Fiz.: 57: 1778-89(Nov 1969). (In Russian).**

The distribution function, mean energy, mean energy losses, mobility and thermal conductivity are calculated for slow electrons ($\epsilon < \omega$) in a weakly ionized molecular plasma by taking into account inelastic processes. Rotational and vibrational transitions in the molecules colliding with electrons are taken into account by the correlational function method. The quasi-classical rotational correlation functions are obtained for linear molecules and molecules of the symmetric gyroscope type. (auth)

8464 PARTICLE DISTRIBUTION AND THE ELECTRIC FIELD IN THE VICINITY OF A BODY MOVING SLOWLY IN A RAREFIED PLASMA. **Moskalenko, A. M. (Inst. of Geomagnetism, Ionosphere, and Radio Wave Propagation, Moscow). Zh. Eksp. Teor. Fiz.: 57: 1790-4(Nov 1969). (In Russian).**

Expressions for the concentration and the current densities of particles in the vicinity of a charged spherical body moving in a rarefied plasma are derived and analyzed. The equations for the electric field are also written down. The body dimensions are assumed to be small compared with the particle mean free path and its velocity small compared to the ion thermal velocity. (auth)

8465 IONIZATION-CAUSED COLUMN CONTRACTIONS. III. INFLUENCE OF VOLUME RECOMBINATION. **Wojaczek, Karl (Deutsche Akademie der Wissenschaften zu Berlin). Beitr. Plasmaphys.; 9: 243-59(1969). (In German).**

The positive column of a plasma is studied in a simplified model, especially its contraction under ionization. Mathematical formulas and 18 diagrams depict the findings. Discrepancies between theoretical and experimental values require further investigation. (H.B.G.)

8466 UNIFIED MODEL FOR STARK BROADENING. **Voslamber, D. (EURATOM-CEA, Fontenay-aux-Roses, France). Z. Naturforsch.; 24a: 1458-72(Oct 1969).**

Stark broadening of spectral lines is considered as a semi-classical many-body problem. Starting from a Liouville equation for a distribution function depending on the atomic Hilbert space vector and the coordinates and velocities of the classical plasma particles, BBGKY hierarchy techniques are used to derive a complete line profile for the electron contribution. The line shape formula is expressed in terms of the atomic time evolution operator for a collision with a single plasma electron. This operator is approximated by a strictly unitary exponential expression, yielding more accuracy than second-order perturbation theory and being valid also in the quasi-static limit. The resulting line shape expression covers the whole frequency domain from the impact regime to the quasi-static regime. The results of the impact and quasi-static approximations are recovered as special cases for small and large distances from the line center. A numerical application to Lyman-α shows very good agreement with an experiment of Boldt and Copper. (auth)

8467 INVESTIGATIONS ON CURRENT DENSITY DISTRIBUTION OF AN ARC IN A MAGNETIC FIELD. **Klueber, O. (Institut fuer Plasmaphysik, Garching, Ger.). Z. Naturforsch.; 24a: 1473-91(Oct 1969). (In German).**

In a cylindrical arc without external magnetic field and radius of the discharge current is identical with that of the conductive plasma column. It is shown here that, in general, this is not the case in an arc with superposed magnetic field. Instead, the current is limited by the magnetic flux tube whose cross section is governed by that of the electrodes. This is still true if the radius of the conductive plasma column is much larger than that of the flux tube. In this case electromotive forces prevent radial expansion of the current-carrying region and form a potential distribution in keeping with the current density distribution. (auth)

8468 INFLUENCE OF RADIATIVE ABSORPTION ON THE ESTABLISHMENT OF LOCAL THERMODYNAMIC EQUILIBRIUM. **Drawin, H. W. (CEN, Fontenay-aux-Roses, France). Z. Naturforsch.; 24a: 1492-6(Oct 1969).**

By solving the coupled system of collisional–radiative rate equations for a homogeneous and steady-state plasma as a function of the radiative excitation rates, one obtains the population densities of the ground and excited levels for any given degree of reabsorption. One finds that in hydrogen plasmas which are completely optically opaque towards all Lyman lines, and partially optically opaque towards Hα, the equilibrium populations will not be established for electron densities below 1×10^{16} cm^{-3}. (auth)

8469 KINETIC-THEORETICAL STUDIES OF THE SHOCK WAVE STRUCTURE. **Muraoka, Katsunori; Murakami, Terutosi; Ikui, Takefumi (Kyushu Univ., Fukuoka). Phys. Fluids: 12: 2522-30(Dec 1969).**

The one-dimensional, steady, neutral shock wave structure was theoretically investigated by expanding the distribution function of

the Boltzmann equation in terms of the Hermite polynomials, where the downstream equilibrium distribution function is taken to be the weighting function. The resulting nonlinear coupled differential equations were numerically integrated and various thermodynamic variables were calculated; reasonable results were obtained for low (where Navier–Stokes approximations are thought to be correct) and high (where Mott–Smith treatment was seen to be appropriate) Mach numbers. The thermodynamic background of the present treatment is thoroughly discussed and criticism of various other theoretical methods is made. (auth)

8470 STRUCTURE OF HYDROMAGNETIC IONIZING SHOCK WAVES. Molander, Roger C.; Berger, Stanley A. (Univ. of California, Berkeley). Phys. Fluids; 12: 2531-44(Dec 1969).

A physical model is formulated to describe the changes taking place within a strong ionizing shock wave in the presence of electromagnetic fields. The model assumed is composed of a strong adiabatic shock to translational equilibrium followed by initiation of ionization and interaction between the flow and the electromagnetic fields. Eventually, recombination causes the flow to relax to a downstream state of thermodynamic equilibrium and zero current flow. Mathematical equations are derived to describe the changes in flow parameters and electromagnetic fields within the nonequilibrium current-carrying region for an arbitrary gas and arbitrary upstream magnetic field configuration. The analysis removes the indeterminacy in the solution of the shock jump conditions arising from the inability to fix the upstream electric field for ionizing shock waves. The particular case of switch-on shock waves in argon is then considered in detail. Solutions were only found when the downstream transverse magnetic field component was much less than the axial component. (auth)

8471 SHIELDING OF SLOW TEST PARTICLES IN A PLASMA. Cooper, Gilbert (Univ. of California, Livermore). Phys. Fluids; 12: 2707-10(Dec 1969).

The effective field of a test particle moving slower than the electron thermal velocity is calculated. Within a few Debye lengths, the field exhibits the usual exponential shielding. At further distances, the velocity induced r^{-3} field is seen. (auth)

8472 ELECTRICAL CONDUCTIVITY OF A COLLISIONLESS MAGNETOPLASMA IN A WEAKLY TURBULENT MAGNETIC FIELD. Newman, C. E.; Sturrock, P. A. (Stanford Univ., Calif.). Phys. Fluids; 12: 2553-8(Dec 1969).

The behavior of test particles in the presence of uniform, parallel, and steady electric and magnetic fields in addition to a weakly turbulent magnetic field is studied. The quasi-linear approach is used to find a diffusion equation for the distribution function describing the test particles; the diffusion equation describes the pitch-angle scattering experienced by the test particles due to the random fluctuations of the magnetic field. In the weak-electric-field limit the equation is analyzed in detail and an expression for the electrical conductivity in terms of the correlation tensor of the fluctuating field is found. Finally, for the case of a particular model of the turbulence and a Maxwellian distribution of test particles, an explicit formula for the conductivity is given. (auth)

8473 APPLICATION OF KUBO'S MODIFIED THEORY OF BROWNIAN MOTION TO A PLASMA. Walsh, John E. (Dartmouth Coll., Hanover, N. H.). Phys. Fluids; 12: 2559-62(Dec 1969).

Kubo's modified theory of Brownian motion is used to calculate the friction experienced by a plasma electron. It is found that the spectral decomposition of the average Coulomb interaction is similar in functional form to the Landau damping decrement. It is also shown that when this friction is summed over the large wavenumber region of the spectrum the usual collision frequencies result. (auth)

8474 HIGH-FREQUENCY CONDUCTIVITY OF A PLASMA WITH FLUCTUATIONS. Nishikawa, Kyoji (California Inst. of Tech., Pasadena); Ichikawa, Yoshi-hiko. Phys. Fluids; 12: 2563-73(Dec 1969).

The induced current density of a fully ionized, stationary, and uniform plasma linear in the externally applied, high-frequency electric field is calculated. In the calculation two approximations are made: neglect of the spatial dependence of the external field and neglect of the mode-coupling terms which do not significantly contribute to damping of the waves. For large ion-to-electron mass ratios, the Ohmic current can be expressed as a simple function of the density fluctuations of the electrons and those of the ions. Results previously obtained for a quiescent plasma can easily be recovered by using the expressions for these fluctuations one obtains from the velocity distribution functions in the random phase approximation. Each of the three different types of enhanced fluctuations, corresponding to the ion–acoustic, the ion plasma, and the electron plasma waves, respectively, is found to have a different effect on the resistivity. The range of frequencies of the external field in which the effect of fluctuations is important, the sign of the additional resistivity due to fluctuations, and a quantitative estimate of this resistivity in some special cases are discussed. (auth)

8475 GYROMAGNETIC EFFECT ON THE MOBILITY OF CHARGED PARTICLES IN WEAKLY IONIZED GASES. Tsuda, Takao; Fukao, Shoichiro; Maeda, Ken-ichi (Kyoto Univ.). J. Appl. Phys.; 40: 5280-9(Dec 1969).

In crossed electric and magnetic dc fields, gyrating electrons are subject to alternate acceleration and deceleration by the electric field. This speed modulation occurs with the gyrofrequency and periodically changes the colliding electron's velocity relative to the background neutral particles. Thus these orbiting electrons see the collision cross-sectional area, associated with target neutral particles, as if it were varying with the gyrofrequency. In very weakly ionized gases, this effect of time-varying collision probability can cause deviated random walk of guiding centers in the direction of the electric field applied perpendicular to the dc magnetic field. It is proposed and argued that the conventional Chapman–Cowling type formula giving the Pedersen mobility needs to be reexamined in the light of this new effect. Results of computer simulation indicate that the value of the Pedersen mobility of electrons differs considerably from that given by the conventional formula. (auth)

Production

8476 DEVICE FOR PRODUCING HIGH-TEMPERATURE PLASMA. Matsuda, Nisaku (to Tokyo Shibaura Electric Co.). Japanese Patent 1969-19320. 21 Aug 1969. Filed 14 Jun 1965.

The device consists of the following: a plasma vessel; a means for producing plasma and heating it in the vessel; coils wound around the vessel, for containing the plasma in the central direction; ac power source for supplying current to the plasma-containing circuit via a making-up device and a main discharge gap; a control, excited in connection with the ac power source, for operating the making up device at a first specific phase of the voltage in the power source; a control circuit, excited in connection with the power source, for producing discharge in the main discharge gap at a second specific phase of the voltage in the power source; and a control, excited by the voltage between the terminals of the plasma-containing coil due to the current caused by the discharge in the main discharge gap, which operates the means of producing and heating plasma, at a specific time after start of the discharge. (2) In addition to the above, the control circuit for producing discharge in the main discharge gap, has a series circuit using a condenser for producing the discharge, and an auxiliary discharge gap, and this series circuit is connected parallel to the main discharge gap. (NSA of Japan)

8477 SOURCES OF HIGHLY STRIPPED IONS. Peacock, N. J.; Pease, R. S. (Culham Lab., Abingdon, Eng.). J. Phys., D (London); 2: 1705-6(Dec 1969).

The condition that $n\tau$, the product of density and containment time, is sufficiently high to strip ions almost to their "steady-state" degree of ionization can be achieved in certain high-density pulsed devices of thermonuclear interest. One such plasma, that produces when a solid pellet is irradiated by a Q-spoiled laser beam, appears promising as a source of highly stripped ions. Present calculations show that the ions could be extracted for acceleration experiments with a mean charge exceeding ten. (auth) (UK)

8478 TEMPERATURE PROFILES AND ENERGY BALANCES FOR AN INDUCTIVELY COUPLED PLASMA TORCH. Miller, Reid C.; Ayen, Richard J. (Univ. of California, Berkeley). J. Appl. Phys.; 40: 5260-73(Dec 1969).

A mathematical model was developed to predict radial and axial temperature profiles in an induction-coupled plasma torch. The model employed temperature-dependent physical properties and included radiation heat loss. Temperature fields based on the model were calculated for an atmospheric pressure argon plasma. Computed radial temperature profiles were in agreement with experimental profiles reported in the literature. The gas flow rate and flow pattern in the torch did not greatly affect the radial temperature profiles in the hottest region of the torch under ordinary operating conditions, also in agreement with experiment. A one-dimensional analysis was developed which predicted these hot-spot profiles accurately. The plasma model was also found to accurately predict distribution of energy losses from the plasma. Based on the equilibrium current density and temperature profiles provided by the model, the question of the existence of local ther-

modynamic equilibrium was re-examined. It was concluded that equilibrium is closely approached in the high-temperature central portion of the plasma, in agreement with previous investigators; however, nonequilibrium conditions can exist in the region of high temperature gradient at the plasma edge. (auth)

Stability

Refer also to abstracts 8362, 8384, 8490, 8495, and 8500.

8479 INSTABILITIES OF PLASMA WITH INTENSE AZIMUTHAL STREAMS AND RADIALLY DEPENDENT DENSITY. Jungwirth, K.; Petrzilka, V. A. (Inst. of Plasma Physics, Prague). Czech. J. Phys.; 19: 1329-36(1969).

The flute instabilities of a cold magnetoactive plasma with radially dependent density and strong azimuthal streams of particles (ions) are studied. The effect of nonzero perpendicular temperature $T_\perp$ of the ions on these oscillations is investigated. For systems with $T_\perp \neq 0$, the continuation of drift-cyclotron instability in a strongly inhomogeneous plasma is found. Further, the stability of electron plasma oscillations ($\omega^2 \approx \omega_{pe}^2 \cos^2 \Theta$) is investigated. (auth)

8480 AMBIPOLARITY AND PLASMA STABILITY. Robertson, Harry S. (Univ. of Miami, Coral Gables, Fla.). Phys. Rev.; 188: 288-90(5 Dec 1969).

The following statement is offered as a conjecture. Given two otherwise identically prepared plasmas: If one has $\vec{j} \cdot d\vec{A} = 0$ at every point of the boundary (except those points that carry essential currents), and the other permits nonessential currents to the plasma boundaries, the former will be more stable and better confined. A general theoretical argument in support of this conjecture (not a rigorous proof) is offered, based on the principle of minimum entropy-production rate. Experimental evidence in support of the conjecture is cited. (auth)

8481 ACOUSTIC INSTABILITY IN WEAKLY IONIZED GASES. Kaw, P. (Princeton Univ., N. J.). Phys. Rev.; 188: 506-8(5 Dec 1969).

It is shown, in contrast with earlier work, that energy transfer between hot electrons and neutrals in a weakly ionized gas does not lead to an acoustic instability, if proper care is taken to account for the nonstationary nature of the neutral equilibrium. (auth)

8482 ION RESONANCE INSTABILITY IN GROSSLY NONNEUTRAL PLASMAS. Levy, R. H. (Avco Everett Research Lab., Everett, Mass.); Daugherty J. D.; Buneman, O. Phys. Fluids; 12: 1616-29(Dec 1969).

The addition of a certain fraction of ions to an otherwise stable cloud of electrons can, in certain circumstances, result in an instability. The case of a low-density ($q = \omega_p^2/\omega_c^2 \ll 1$) electron cloud in which the electron motions can be described by $E + v_e \times B = 0$ is considered in detail. The condition for onset of the instability is that the unperturbed ion orbits (which characteristically traverse the entire electron cloud) should involve frequencies close to that of the diocotron wave that can propagate on the electron cloud. This condition is equivalent to having the ratio Zm_e/m_iq of the order of unity and is independent of the ion density. When instability is present, the growth rate is of the order of the ion plasma frequency. (auth)

8483 QUASILINEAR THEORY OF THE POSITIVE COLUMN SPIRAL INSTABILITY. Simon, Albert; Shiau, J. N. (Univ. of Rochester, N. Y.). Phys. Fluids; 12: 2630-7(Dec 1969).

An analysis of the nonlinear behavior of the spiral instability of the positive column is presented. The finite amplitude and frequency shift of the single mode which results from raising the magnetic field slightly above the critical value are determined. The slope of the E–H curve is also obtained. The method is based on a general theory of nonlinear behavior in weakly ionized plasma. The quasi-linear results are in excellent agreement with experiment. (auth)

Thermonuclear Processes

8484 (AEC-tr-7116) MAGNETIC CONFIGURATIONS WITH A SHEAR AND MINIMUM B. Aleksin, V. F.; Romanov, S. S.; Sebko, V. P.; Loktionov, Yu. M. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). Translation of report FTI-217. 20p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 36724. (M.O.W.)

8485 (AEC-tr-7118) FORMING HIGH-FREQUENCY FIELDS IN PLASMA DEVICES. Zverev, G. I.; Sabchenko, I. S.; Maiburov, V. B.; Lyul'ev, V. L.; Burdiashvili, M. Sh. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Sukhumi. Fiziko-Tekhnicheskii Institut). Translation of report NP-17893. 13p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 32486. (M.O.W.)

8486 CALCULATIONS OF THE NEUTRON EMISSION OF A D–T PLASMA PRODUCED BY A HIGH-PINCH DISCHARGE. Frank, R. G. A.; Klingelhoefer, R. (Univ., Karlsruhe, Ger. Kernforschungszentrums, Karlsruhe, Ger.). Z. Naturforsch.; 24a: 1632-6(Oct 1969). (In German).

The number of neutrons per discharge emitted during the collapse of a hollow D–T Z pinch is calculated. In the system of differential equations describing the radial acceleration of the cylinder by Lorentz forces, the internal pressure of the sheath is incorporated. Due to the pressure term, it is possible to calculate the time dependence of density, temperature, and reaction rate within the sheath. Using a capacitor bank of 200 kJ at 100 kV and a hollow cylinder of 30 cm initial radius and 10 cm height the emission of 3×10^{13} neutrons is expected during the implosion phase, lasting a few nsec. The optimization of the experimental parameters for maximum neutron emission is given. (auth)

8487 RESEARCH ON CONTROLLED NUCLEAR FUSION: PROGRESS AND PROSPECTS. Pease, R. S. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Phys. Bull. (London); 20: 515-19(Dec 1969).

The subject is discussed under the following headings: introduction; magnetic confinement of plasma; possible reactor systems; and prospects. (UK)

8488 MAGNETIC GUARDING OF SUPPORTS. Lehnert, B. (Royal Inst. of Tech., Stockholm). Phys. Fluids; 12: 2710-11 (Dec 1969).

It is shown that so far there is no experimental proof that magnetic guarding is ineffective, contrary to conclusions drawn from a strongly restricted plane model. (auth)

Wave Phenomena

Refer also to abstract 8424.

8489 (CEA-R-3720) CONTRIBUTION TO THE EXPERIMENTAL STUDY OF WAVE–PARTICLE INTERACTIONS IN A PLASMA HAVING A TWO-POPULATION ELECTRON DISTRIBUTION FUNCTION. Frank, Rene (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Sep 1969. 72p. (In French). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Univ. of Paris, Faculte des Sciences, Orsay, France.

The interaction between electrostatic waves and electrons in a plasma characterized by a so called "bump in tail" distribution function was studied. It was necessary to measure precisely the electron distribution and its evolution in space or in time. This was performed with a specially designed electrostatic separation probe. The evolution in space and time of the noise spectrum was also measured. This mechanism was studied in two different regimes of the discharge. In the first case the distribution function is very close to that describing the interaction of a semi-infinite plasma with a cold beam injected at its edge. In the second case the conditions necessary for the quasi-linear theory to be valid are satisfactorily fulfilled. (auth)

8490 (COO-1695-25) PLASMA INSTABILITIES AND WAVE EXCITED BY AN ANISOTROPIC ENERGY DISTRIBUTION PRODUCED BY ELECTRON CYCLOTRON RESONANCE. Annual Progress Report. Shohet, J. L. (Wisconsin Univ., Madison. Dept. of Electrical Engineering). 15 Dec 1969. Contract AT-(11-1)-1695. 65p. Dep. CFSTI.

The research performed under this contract involves the study of plasmas produced by electron cyclotron resonance heating in a magnetic mirror device. Specifically, the work has centered on three major problems: (I) The measurement of free-free bremsstrahlung from the plasma and the theoretical problem of relating the results to the electron energy distribution. (II) The measurement of parallel and perpendicular electron energies by means of an $\vec{E} \times \vec{B}$ analyzer and diamagnetic loop along with microwave diagnostics, and the comparison of the results with theoretical predictions and with the results of computer simulation. (III) The investigation and identification of an electromagnetic instability. This report summarizes the progress in the above areas during the period of December 15, 1968 to December 14, 1969 and outlines a program for further theoretical and experimental effort. (auth)

8491 (NYO-1480-127) COLLECTIVE MODES IN AN INHOMOGENEOUS ELECTRON GAS. Newman, Joyce; Percus,

Jerome K. (New York Univ., N. Y. AEC Computing and Applied Mathematics Center). Oct 1969. Contract AT(30-1)-1480. 157p. Dep. CFSTI.

This study is paralleled after J. Hubbard's treatment of collective modes in the uniform electron gas and differs mainly in the mathematical complexity. Large contributions to the correlation energy are identified with collective modes and this identification provides conditions for the frequency and lifetime of these modes. The contributions to the correlation energy are analyzed via diagrammatic techniques where the Coulomb interaction between the electrons is replaced by a modified interaction. Only first-order or "bubble" diagrams are considered, and this is equivalent to the random phase approximation. The modified interaction is obtained from a certain integral equation whose solution is approximated by a variational principle. The kernel of this integral equation depends upon the density operator for the system of electrons with an external potential. The solution of the problem is formulated in two different ways, by using two different approximations for a closed form of the density operator. The first method uses a variational principle for the Green's function of the system and the second method uses a corrected Thomas–Fermi density operator which is valid for slowly varying potentials. Both methods require numerical techniques for their completion and these are carried out only for the second method. An application is made to atomic type systems and two undamped collective modes are found. One is a very singular resonance at 54 Å and the other is a broad resonance between .24 and .46 Å. (auth)

8492 (UCRL-19085) CYCLOTRON ECHOES IN Cs VAPOR. Shaner, John Wesley (California Univ., Berkeley. Lawrence Radiation Lab.). Oct 1969. Contract W-7405-eng-48. 99p. Dep. CFSTI.

Thesis.

Cyclotron echoes have been studied in a weakly ionized cesium plasma in a magnetic field. The behavior of the multiple echoes following two resonant microwave pulses (two-pulse echoes) and those following three resonant microwave pulses (three-pulse echoes) are shown for various pulse spacings and neutral Cs densities. These results are compared with various theoretical models. On the basis of this comparison, the velocity dependence of the electron–neutral collision frequency is chosen as the mechanism for two-pulse echo generation. Several mechanisms are invoked to explain the three-pulse echoes, including scattering without diffusion and diffusion across flux lines. A detailed comparison is made between the results from these models and the experimental results. (auth)

8493 WAVE PROPAGATION IN RANDOM MEDIA. Frisch, U. (Centre National de la Recherche Scientifique, Paris). pp 75-198 of Probabilistic Methods in Applied Mathematics. Vol. I. Bharucha-Reid, A. T. (ed.). New York, Academic Press Inc., 1968.

Some general methods for linear stochastic equations are described. The application of some of these methods to wave propagation in random media is discussed. (M.O.W.)

8494 GENERAL SOLUTION OF A SYSTEM OF EQUATIONS FOR ACOUSTIC WAVE PROPAGATION IN A PARTIALLY IONIZED GAS IN AN EXTERNAL ELECTRIC FIELD. Aubrecht, L. (Technical Univ., Prague). Czech. J. Phys.; 19: 1322-8 (1969).

A system of equations describing the propagation of acoustic waves in multicomponent partially ionized plasma in an external electric field is solved generally, when these waves are generated by an external neutral sound wave in plasma. The equations are solved by means of Laplace transformation. It is found that a sound wave generates a group of waves with different frequencies and wave vectors. For the sake of comparison, the solution without an external field and the linear solution in the form of waves having the same frequencies as the frequency of the excitation wave are given. (auth)

8495 WAVES AND INSTABILITIES IN FINITE PLASMAS. Cheng, Chien-chung. Knoxville, Tenn.; Univ. of Tennessee (1968). 128p.

Thesis.

The second quantization method is used to drive an integro–differential equation for $\phi(\vec{x},t)$, a small perturbation of the electrostatic potential due to plasma oscillations. By this equation and boundary conditions, the plasma dispersion relation for electrostatic longitudinal waves may be obtained. The quantum-mechanical derivation of dispersion relations is applicable to both the infinite and the finite plasmas. The application to unmagnetized and magnetized infinite plasmas leads to the usual dispersion relations which were derived classically from the Vlasov equations. For unmagnetized and magnetized plasma slabs, a common dispersion relation is obtained. In this case, both classical and quantum mechanical derivations are given. In the quantum mechanical derivation some extra terms appear, which do not appear in the classical derivation. These terms which vanish when the classical limit is taken, are due to finite De Broglie wavelength of the particles. For classical problems under consideration, the dispersion relation for plasma slabs is surprisingly simple in form. This dispersion relation is applied to the investigation of volume and surface plasma oscillations and volume and surface ion sound waves in an unmagnetized plasma slab and to volume waves in magnetized plasma slabs. The oscillation frequencies and the damping of volume waves are nearly the same as those of corresponding infinite plasma waves. The oscillation frequencies and the damping of surface waves are quite different. Finally, a dispersion relation is derived classically for a magnetized "sandwich" plasma. An application is given to the case of hot ions embedded in cold electrons. (Diss. Abstr.)

8496 DESTRUCTION OF A LARGE AMPLITUDE ION-ACOUSTIC WAVE. Alikhanov, S. G.; Sagdeev, R. Z.; Chebotaev, P. Z. (Inst of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 57: 1565-9(Nov 1969). (In Russian).

A numerical experiment on propagation of a powerful ion–acoustic wave in a one-dimensional plasma model is performed on an electronic computer. The nature of overturning of the wave front at large Mach numbers is investigated, and it is found that it is of a pulsation type (with a frequency of the order of the plasma ion frequency). (auth)

8497 PARAMETRIC EXCITATION OF SURFACE OSCILLATIONS OF A PLASMA BY AN EXTERNAL HIGH FREQUENCY FIELD. Aliev, Yu. M.; Ferlengi, E. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 57: 1623-8(Nov 1969). (In Russian).

An equation set describing linear oscillations of a bounded plasma in an external high-frequency field is derived on basis of the hydrodynamics equations and Maxwell equations. The dispersion relation for the potential surface oscillations of a plane layer and a cylinder is deduced from the set. It is shown that new branches arise in the surface oscillation spectrum of a plasma located in a high-frequency field. The surface oscillations are unstable in a broad range of frequencies of the external field. (auth)

8498 A STUDY OF THE PROPAGATION OF FAST MAGNETO-ACOUSTIC WAVES THROUGH THE PLASMA PLACED IN THE FIELD OF THE THREAD OF A CURRENT USING GEOMETRICAL OPTICAL TECHNIQUES. Deutsch, R. V. Rev. Roum. Phys.; 14: 833-40(1969).

A study is presented on the propagation of fast magnetohydrodynamic waves through a plasma placed in the magnetic field of the thread of a current. At Alfvén velocity exceedingly higher than the sound velocity, Fermat's principle is applicable in the form known from geometrical optics. By applying the above-stated principle, the general integral of the Hamilton–Jacobi equation is obtained, which is subsequently used in two boundary cases, viz. wave surfaces invariant to the displacement along the thread of the current and wave surfaces with axial symmetry. (auth)

8499 NONLINEAR, COLLISIONLESS, PLASMA WAVES. Allis, William P. (Massachusetts Inst. of Tech., Cambridge). Contracts W-7405-Eng-36; AT(30-1)-1842. pp 21-42 of In Honor of Philip M. Morse. /Feshbach, Herman; Ingard, K. Uno (eds.). Cambridge, Mass.; Massachusetts Institute of Technology Press (1969).

A distribution is postulated, which is no more arbitrary than that postulated in linear theory and reduces to the latter for small amplitudes. Its integral is real and Poisson's equation is solved, as in the theory of space charge sheaths, as an integral over the potential. Potential profiles, and undamped dispersion relations follow immediately. The two constants of integration determine the amplitude of the wave and the current "induced" by it. The current is proportional to the arbitrary constant in van Kampen's dispersion relation. The above dispersions follow from a distribution of trapped electrons which is called "normal." It is shown: (a) that an antisymmetric distribution of trapped electrons leads to damping and to oscillations at the pendular period, and (b) that abnormal symmetric distributions introduce the subharmonic and do not tend towards the linear theory for small amplitudes. (M.O.W.)

8500 FEEDBACK STABILIZATION OF DRIFT WAVES BY MODULATED ELECTRON SOURCES. Furth, H. P.; Rutherford, P. H. (Princeton Univ., N. J.). Phys. Fluids; 12: 2638-41 (Dec 1969).

A theory is presented for feedback stabilization of collisional and collisionless drift waves by modulated electron sources within the plasma, such as may be provided by probes responding to the measured electron density perturbation. (auth)

8501 DISPERSION OF ION-ACOUSTIC WAVES. Joyce, Glenn (Univ. of Iowa, Iowa City); Lonngren, Karl; Alexeff, I.; Jones, W. D. Phys. Fluids; 12: 2592-9(Dec 1969).

The dispersion of ion-acoustic waves in quiescent rare-gas discharge plasmas were investigated experimentally and theoretically. Experimentally, various grid systems were used to generate the waves which were studied using a time-of-flight technique. The experimental results show that two separate propagating phenomena appear. The slower propagating disturbance is the ion-acoustic wave, obeying the theoretically predicted dispersion behavior. The faster propagating disturbance, though superficially resembling a wave, is composed of bursts of ions produced by the driving potentials placed on the grids and would appear to be related to the "free streaming" term found by Landau. Previous theoretical models of ion-wave propagation have utilized either purely initial-value or steady-state, boundary-value calculations. A model is presented which more nearly simulates the experimental time-of-flight studies of finite packets of ion waves generated by finite sine-wave bursts. (auth)

8502 SPATIAL GROWTH OF WAVES IN A BEAM-PLASMA SYSTEM. Malmberg, J. H.; Wharton, C. B. (Gulf General Atomic Inc., San Diego, Calif.). Phys. Fluids; 12: 2600-6 (Dec 1969).

An experiment on spatially growing electron plasma waves in a beam-plasma system is described. The properties of the electron beam and the plasma separately are known from accurate, independent measurements. Using a "test wave" technique, the dispersion of the waves in the presence and absence of the beam and their linear growth rate as a function of frequency were measured. The growth of a spectrum of waves from broad-band noise and the termination of the growth due to nonlinear effects were observed. (auth)

8503 LOW-FREQUENCY WAVES AND INSTABILITIES ON THE POSITIVE COLUMN IN A MAGNETIC FIELD. III. EXPERIMENTS ON THE m = 1 AZIMUTHAL MODE. Duncan, A. J.; Forrest, J. R.; Crawford, F. W.; Self, S. A. (Stanford Univ., Calif.). Phys. Fluids; 12: 2607-16(Dec 1969).

In papers I and II of this series [Phys. Fluids, 12: 303 and 316 (1969)], a theory describing low-frequency wave propagation along a weakly ionized positive column in a magnetic field, B_z, was developed and studied numerically. Paper III describes experimental verification of the analysis, based on observation of electron waves propagating along a low-pressure mercury-vapor discharge. The theory predicts that for propagation in the direction of the axial electron drift, an azimuthal mode number $m \geq 1$, and rotation in the sense of the electron diamagnetic drift, these helical waves should show a transition with increasing B_z from damping to spatial growth. Measurements of the wave dispersion characteristics as a function of B_z are presented for the first two radial modes of m = 1. They show reasonable quantitative agreement with theory. The behavior of the spectrum of self-excited waves, and the dependence of the steady axial electric field on B_z, are interpreted in terms of the linear perturbation theory. It is suggested that, for a low-pressure discharge, instability sets in first for high-order modes, localized near the outer radius, and spreads to low-order modes as B_z is increased. (auth)

8504 FINITE LARMOR RADIUS EFFECTS IN PLASMADYNAMICS: MAGNETOSONIC DISTURBANCE. Kinsinger, R. E.; Auer, P. L. (Cornell Univ., Ithaca, N. Y.). Phys. Fluids; 12: 2574-9(Dec 1969).

A disturbance of finite amplitude propagating across an initially uniform axial magnetic field within an initially uniform plasma of infinite extent is considered. The Vlasov equation is solved explicitly to second order in the adiabatic smallness parameter $\epsilon = (\omega T)^{-1} = (R/L)$, with symbols defined in the text. It is shown also that the hierarchy of moment equations resulting from the Vlasov equation may be ordered to yield directly an expansion in powers of ϵ. The two methods yield equivalent results to second order. The fluid dynamic equations for each plasma species along with Maxwell's equations form a complete set which can be terminated consistently in second order. As an illustration, the dispersion of linearized magnetosonic waves to second order in ϵ is obtained. (auth)

8505 FINITE LARMOR RADIUS EFFECTS IN THE MAGNETOSONIC PULSE. Kinsinger, R. E.; Auer, P. L. (Cornell Univ., Ithaca, N. Y.). Phys. Fluids; 12: 2580-5(Dec 1969).

A consistent second-order adiabatic closure for the fluid description of a magnetosonic disturbance was developed earlier. Here, that closure is adapted for the description of a steady, nonlinear, dissipation-free pulse. The Adlam-Allen solitary wave is recovered in the limit where the electron inertial dispersion dominates. When the dispersive effects of finite ion Larmor radius dominate, the pulse remains compressive but scales with the ion Larmor radius. The laminarity of this solution fails due to cavitation of the ion fluid. For small ion beta, this pulse break occurs for weakly nonlinear, yet not truly adiabatic, disturbances. (auth)

8506 SPECTROSCOPIC INVESTIGATION OF ENHANCED PLASMA OSCILLATIONS IN A HIGH-VOLTAGE THETA PINCH. Kunze, H.-J.; Griem, H. R.; DeSilva, A. W.; Goldenbaum, G. C.; Spalding, I. J. (Univ. of Maryland, College Park). Phys. Fluids; 12: 2669-76(Dec 1969).

Intensity and frequency of fluctuating electric fields are obtained from a "plasma satellite" on the 2^1P-4^1D line of helium observed in the piston field of a collisionless shock. In contrast to second-order perturbation theory only one satellite is seen. The perturbation theory is developed, therefore, to higher orders. Agreement between this theory and experiment is achieved. From the observed level of electric field fluctuations an effective collision frequency of about one-fourth of the ion plasma frequency can be deduced. (auth)

8507 SCALAR RADIATIVE TRANSPORT MODEL FOR MICROWAVE SCATTERING FROM A TURBULENT PLASMA. Feinstein, David L. (Cornell Aeronautical Lab., Inc., Buffalo); Granatstein, Victor L. Phys. Fluids; 12: 2658-68(Dec 1969).

The scalar radiative transport equation is solved in an iterative manner for the backscattered reflected intensity. A model for the direct and cross-polarized cross section is derived in terms of the first two terms of the iterated series. Model calculations agree to good approximation with an experiment where microwaves are scattered from a turbulent plasma column. At very low plasma density fluctuations (less than 0.01 of the critical plasma density) a single scatter regime exists where the direct cross section is proportional to the square of the plasma density fluctuations and the cross-polarized cross section is much less than the direct cross section. As the fluctuations increase, this single scatter regime is followed by a regime where multiple scattering makes a significant contribution to the backscattered signal; here, the magnitude of the cross-polarized cross section is approximately 0.1 of the magnitude of the direct cross section. Finally, when the plasma density fluctuations are about 0.1 of the critical plasma density, the wave is strongly attenuated by scattering and the cross sections saturate as a function of the plasma density fluctuations. The model also predicts the observed variation of the cross section with angle of incidence. Suggestions for future work are made. (auth)

8508 SURFACE WAVE PROPAGATION AND AMPLIFICATION BY BEAM/PLASMA INTERACTION. Ristic, V. M.; Self, S. A.; Crawford, F. W. (Stanford Univ., Calif.). J. Appl. Phys.; 40: 5244-60(Dec 1969).

This paper concerns propagation of surface waves along a plasma column, and their amplification by interaction with an electron beam penetrating the plasma. First, surface wave propagation is analyzed for stationary and drifting plasmas. In addition to undamped propagation, the dispersion relation describes infinite sets of modes which can be categorized as evanescent and damped propagating waves. Next, it is shown how surface waves can be driven unstable by an electron beam. When the beam partially fills the plasma, interaction may occur not only with surface waves but also with plasma oscillations. A detailed stability analysis for the case of beam filling the plasma shows that the system may be either convectively or absolutely unstable, depending on the beam parameters. These findings are compared with the predictions of weak coupled mode theory, which are demonstrated to be misleading. Experiments aimed at measuring surface wave amplification, and checking the theory, are described. The propagation observed is interpreted as a beating between a weakly growing and a damped surface wave. The maximum growth corresponded to an electronic gain of 2 dB/cm at 470 MHz. The paper concludes with a brief discussion of the applicability of the results to development of a practical beam/plasma microwave amplifier. (auth)

8509 SCATTERING OBLIQUELY INCIDENT MICROWAVES BY A MOVING PLASMA COLUMN. Yeh, C. (Univ. of California, Los Angeles). J. Appl. Phys.; 40: 5066-75(Dec 1969).

The problem of the interaction of obliquely incident microwaves with a plasma column which is moving uniformly in the axial direction is treated analytically. An arbitrary polarization for the incident plane wave is assumed. Two methods in solving this prob-

lem are presented. Extensive numerical results for the scattered energy in the backward and broadside directions and the angular distribution of the scattered energy are obtained for various interesting ranges of the parameters involved. It is found that cross-polarized field components are induced even at normal incidence when the plasma medium is moving with respect to the observer and that cross-polarized field components disappear at an incident angle $\theta_0 = \sin^{-1}(v_z/c)$, where v_z is the velocity of the moving plasma and c is the speed of light in vacuum when the plasma column is imbedded in free space. (auth)

8510 EXPERIMENTAL STUDY OF SCATTERING FROM A PLASMA COLUMN. Butterworth, J. E.; Moore, Richard L. (Douglas Aircraft Co., Long Beach, Calif.). J. Appl. Phys.: 40: 5076-83(Dec 1969).

Experiments in microwave scattering from the positive column of a low-pressure (1.2 mtorr) discharge in mercury under steady-state conditions are described. A free-space environment is simulated with an anechoic chamber and a unique c-w cancellation method. Both amplitude and phase of the scattered electric field for both polarizations in the 2.6- to 5.85-GHz frequency range are measured, so that diffraction characteristics, radar cross sections, frequency ratio, and phase shifts are determined. A calibration procedure using silver-plated cylinders provides a higher degree of accuracy than has been attainable heretofore. Diffraction measurements show that, for plane-wave incidence, the scattering is purely dipolar with a 95% confidence interval, except for overdense scattering where a significant monopole term characteristic of conductors is observed. Theoretical comparisons yield an estimate of the electron density distribution function and the damping of the Tonks–Dattner resonances, as well as providing a test of the various theories. The results of some auxiliary experiments to find the average electron density in the column and the effects of wall and mercury reservoir temperatures upon the observed results are also given. (auth)

8511 INTERACTION OF A CYLINDRICAL BEAM WITH A PLASMA. II. EXPERIMENT AND COMPARISON WITH THEORY. Self, S. A. (Stanford Univ., Calif.). J. Appl. Phys.: 40: 5232-43(Dec 1969).

Measurements were made on a beam–plasma system under particularly simple and well-defined conditions. The system could be operated at will in three distinct regimes, namely, (i) a quiescent steady-state regime, (ii) a linear growth regime, and (iii) a nonlinear regime. The steady state is shown to agree with a static theory for a beam-generated plasma. Measurements of spatially growing waves in the linear regime are described and compared with the theory discussed in Pt. I. Reasonable agreement is found when the effects of finite beam radius and collisions are taken into account, but it is indicated that the effect of radial inhomogeneity is also important. Some preliminary measurements on the nonlinear regime are reported and discussed in terms of the available nonlinear and quasi-linear theories. The latter are judged too idealized to account for the nonlinear behavior of real beam–plasma systems and suggestions are made concerning those respects in which they need generalizing. (auth)

8512 INTERACTION OF A CYLINDRICAL BEAM WITH A PLASMA. I. THEORY. Self, S. A. (Stanford Univ., Calif.). J. Appl. Phys.: 40: 5217-31(Dec 1969).

A linear analysis is given of the interaction of a homogeneous, monoenergetic cylindrical electron beam, of radius a, with a homogeneous, cold plasma for two cases: (A) the plasma is unbounded and (B) the plasma is bounded by a conductor at radius b(>a). The quasi-static approximation is compared with an exact treatment, and conditions for the validity of the former are stated. A stability analysis according to the method of Derfler and Briggs is carried out in terms of the mapping of ω into the complex k plane. It is shown that the system is always absolutely unstable and the dependence of the stability analysis on the system parameters is discussed. The absolute instability is, however, always sufficiently weak that in practice the stabilizing effect of collisions is sufficient to quench it, leaving a convective instability. The properties of the amplifying waves resulting from collisional stabilization are discussed for parameter values appropriate to the experimental conditions described in Pt. II. (auth)

8513 ELECTROMAGNETIC WAVE SCATTERING FROM A MAGNETICALLY CONFINED HIGH-TEMPERATURE PLASMA. Nee, S. F.; Pechacek, R. E.; Trivelpiece, A. W. (Univ. of Maryland, College Park). Phys. Fluids: 12: 2651-7(Dec 1969).

Electromagnetic wave scattering from a charged particle confined to a circular orbit is studied for cases where relativistic corrections must be included in the analysis to obtain a valid description for the spatial and spectral distribution of scattered radiation. The results are compared with the scattering calculated on the basis of a two-dimensional isotropic distribution of a straight-line orbits. It is shown that the two calculations produce the same spectrum of scattered radiation provided the fact that the scattering region is finite in the direction of the observer is included in the analysis. (auth)

Shielding

Refer also to abstracts 7700, 8218, 8546, and 8784.

8514 (AD–694434) DIFFERENTIAL MEASUREMENTS OF FAST-NEUTRON AIR–GROUND INTERFACE EFFECTS: PROJECT 9.2, OPERATION HENRE. Final Report. French, R. L.; Mooney, L. G. (Radiation Research Associates, Inc., Fort Worth, Tex.). 15 Jul 1969. Contract DA-20-113-AMC-06121(T). 36p. (RRA-T–95; ATACOM-TR–10590). CFSTI.

The effect of the air–ground interface on the scattered fast-neutron dose near the ground was measured at a distance of 1000 ft from a 14-MeV neutron source. The source was the HENRE accelerator operated at a height of 112 ft on the BREN tower at the Nevada Test Site. A horizontal slab of polyethylene 1 ft thick and 5 ft square with Hurst-type fast-neutron dosimeters mounted on its upper and lower surfaces, separated the neutrons arriving through the upper 2π solid angle from those from the lower 2π. A third detector, mounted on a boom, measured the free-field. The entire assembly was suspended by a hoist system to make measurements at 0.75 to 70 ft above the ground. The scattered dose at the top detector was essentially constant, that at the bottom detector increased by a factor of approximately 2 between 0.75 and 70 ft, and the free-field dose increased by less than 25% over the same height range. The experiment provided confirmation, both qualitative and quantitative, of the "first–last collision model" model" of the air–ground interface effect. (auth) (USGRDR)

8515 (AD–815658) COMPARISON OF DISCRETE-ORDINATES AND MONTE CARLO CALCULATIONS WITH MEASUREMENTS OF FAST NEUTRON SPECTRA IN PARAFFIN SHIELDS. Technical Report, February 17–October 17, 1966. Profio, A. E. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Mar 1967. Contract AF29(601)-7151. 172p. (GA–7521; AFWL-TR–66-153). CFSTI.

Measurements of the fast neutron angular flux spectrum in CH_2 were made in point-source cylindrical geometry, using the same time-of-flight method previously applied to spherical and infinite medium geometries. The work is a continuation of the comparison of accurate, detailed, high-resolution measurements with DTF-IV discrete-ordinate and O5R Monte Carlo calculations. (USGRDR)

8516 (ORO–3858-1, pp 434-97) DESCRIPTION OF SCATTERING IN THE EQUATION OF RADIATIVE TRANSFER. Pomraning, G. C. (Gulf General Atomic, Inc., San Diego, Calif.).

The equation of radiative transfer is discussed, with particular emphasis on the description of the scattering process. The scattering kernel describing photon scattering from a moving distribution of particles is derived. The basic ingredients in this derivation are the assumption that the scattering kernel is known for particles at rest, and the use of the Lorentz transformation to account for the motion of the particles. The case of scattering from a Maxwellian gas of free electrons is considered in detail. It is shown that the assumption of a large electron mass compared to the electron temperature and photon energies of interest leads to a considerable simplification in the scattering description. Specifically, the scattering operator takes the form of a second order differential operator. The eigenvalues problem generated by this operator is studied. In the case of no absorption, analytic results are obtained and the eigenvalue spectrum is found to consist of two discrete points and a continuum. If absorption is present, the eigenvalue problem must in general be approached numerically. It can be shown analytically, however, that the spectrum is entirely discrete for a large class of absorption coefficients. Typical results from numerical calculations are presented. (auth)

Solid-State Physics

Refer also to abstract 8319.

Radiation Effects

Refer also to abstracts 7481, 7660, and 8212.

8517 (AD–689187) CHANNELING IN SEMICONDUCTORS AND ITS APPLICATION TO THE STUDY OF ION IMPLANTATION. Report No. Scientific-1. Picraux, Samuel Thomas (California Inst. of Tech., Pasadena. Dept. of Electrical Engineering). Apr

1969. Contract F19628-68-C-0142. 123p. (AFCRL-69-199). CFSTI.

The channeling characteristics of protons and helium ions in various diamond-type lattices (diamond, Si, Ge, GaP, GaAs, GaSb) have been studied by means of elastic backscattering in the 0.5 to 2 MeV range. Critical angles and minimum yields have been measured and compared to theory. Channeling and electrical measurements are combined to study ion-implanted impurities in silicon. The anneal behavior of Cd and Te implantations (20-50 keV) into Si at substrate temperatures of 23°C and 350°C were investigated. (auth)(USGRDR)

8518 (COO-1198-672) EFFECT OF POINT DEFECTS IN COPPER ON THE ANOMALOUS TRANSMISSION OF X-RAYS. Edelheit, Lewis Selig (Illinois Univ., Urbana). Feb 1970. Contract AT(11-1)-1198. 78p. Dep. CFSTI.

Thesis.

Anomalous x-ray transmission (Borrmann) measurements were made at 4.2°K on nearly perfect copper single crystals before and after irradiation at 20°K with 3-MeV electrons (total integrated flux 0.87×10^{18} electrons/cm^2). The intensity in the diffracted direction was measured for the (111), (222), (333), and (220) reflecting planes. The measured intensity changes were 1.15 ± 0.4%, 4.52 ± 0.6%, 8.90 ± 0.8%, and 4.06 ± 0.8%, respectively. A comparison of the observed intensity changes with theoretical predictions, assuming that the damage consists of isolated interstitials and vacancies, and using previously calculated displacements associated with these defects, indicates that the interstitial is not in the split (100) configuration. Possible configurations are the body-centered interstitial or the split (111) interstitial. Measurements after annealing at 80 and 300°K were made. The measurements indicated that defect clusters were formed when the irradiated crystal was heated to 80°K, and some clusters remained after annealing at room temperature. (auth)

8519 (IAE-1772) HARMONIC FOCUSING EFFECT. Al'tovski I. V. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1968. 8p. (In Russian). Dep. CFSTI (U. S. Sales Only).

A mechanism based on dynamic harmonic theory is proposed for forming focused low-energy collisions. Experiments with neutron irradiation of crystals indicate the existence of long-range (of the order of several lattice constants) interaction between defects during irradiation. The harmonic mechanism is compared with the focusing effect reported by R. H. Silsbee, (J. Appl. Phys., 28: 1246(1957)). (JPRS)

8520 (NYO-3822-17) H CENTER ANNEALING IN GAMMA IRRADIATED KBr. Taylor, A.; Fuchs, W. (Cornell Univ., Ithaca, N. Y. Dept. of Materials Science and Engineering). Sep 1969. 13p. (CONF-690932-1). Dep. CFSTI.

From 10th European Congress on Molecular Spectroscopy, Liege, Belgium.

A study was made of the annealing kinetics of H centers in KBr crystals irradiated at 10°K by ^{60}Co γ rays. The absorption spectrum, luminescence, and conductivity glow peaks were measured. The annealing of the H band at 380 nm and of the thermoluminescence was followed at various temperatures; peaks were observed at 27, 40, and 50°K. It appears that the 27°K peak comprises processes with two distinct activation energies. The annealing kinetics are analyzed. It is suggested that the H center anneals by lattice recombination, and that this occurs by interstitial migration to F centers. (D.L.C.)

8521 FIELD-ION AND ELECTRON MICROSCOPE STUDIES OF LATTICE DEFECTS IN TUNGSTEN AND GOLD. Norden, Hans. Goeteborg; Chalmers Univ. of Tech. (1969). 19p.

Thesis.

A summary is made of eleven published papers by the author and co-authors on the following subjects: Observation of the field-evaporation end form of tungsten; streak contrast in field-ion images from asymmetric specimens; grain boundary dislocations in tungsten wire; observation of dislocations in a tungsten grain boundary by combined electron and field-ion microscopy; fission fragment damage in tungsten studied with the field ion microscope; fission fragment damage in tungsten; vacancy clusters in fission fragment irradiated tungsten; damage in double-positioned gold films bombarded with helium ions; the formation of defect clusters in gold by light ion bombardment; energy dependence of krypton ion damage in gold; and damage in gold bombarded with medium mass ion. (Sweden)

8522 EFFECT OF CHANNELING ON DAMAGE RATES ASSOCIATED WITH HEAVY-ION IRRADIATION OF GOLD. Noggle, T. S.; Barrett, J. H. (Oak Ridge National Lab., Tenn.). Phys. Status Solidi; 36: 761-74(1 Dec 1969).

Electron microscope studies of radiation damage produced by 60-MeV iodine ions in thin gold crystals have been made to determine the dependence of damage rate on orientation of the ion beam relative to [011] and (1$\bar{1}$1). Experimental values of the minimum damage rates and half-widths were compared with calculations made with a Monte Carlo computer program using either the Thomas–Fermi or the Bohr potential and incorporating thermal vibrations. The thermal vibrations were found to be necessary for agreement with experiment, and agreement was better with the Thomas–Fermi potential than with the Bohr. Experimental observations by a stereo technique gave a tentative confirmation of a calculated depth dependence and showed in addition a deficiency of damage clusters near the surface. (auth)

8523 DISLOCATION LOOPS IN NEUTRON-IRRADIATED TUNGSTEN. Galligan, J. M.; Oku, T. (Brookhaven National Lab., Upton, N. Y.). Phys. Status Solidi; 36: K79-82(1 Dec 1969).

Vacancy-type dislocation loops were observed in tungsten irradiated to ~10^{20} nvt by fast neutrons, using a field ion microscope. The plane of the loops was usually {110}. No interstitial-type loops were found. A stacking-fault energy of 4000 ergs/cm^2 was calculated. (D.L.C.)

8524 SYMMETRY OF DEFECT CLUSTERS IN NEUTRON-IRRADIATED SILICON. Sprague, J. A.; Rudee, M. L. (Rice Univ., Houston, Tex.). Phys. Status Solidi; 36: K87-8(1 Dec 1969).

Electron microscopy of neutron-irradiated Si was carried out under two-beam dark field conditions. Two predominant orientations for the line of no contrast are seen at 60° from either side of the operating diffraction vector. The projections of the defects are 30° on either side of the ⟨220⟩ directions. The observations are consistent with a defect model with principal displacements in ⟨111⟩ directions. (D.L.C.)

8525 EFFECT OF PLASTIC DEFORMATION ON RECOVERY OF STAGE I AFTER NEUTRON IRRADIATION. Okuda, S.; Takamura, S.; Maeta, H. (Japan Atomic Energy Research Inst., Tokai). Phys. Status Solidi; 36: 531-8(1 Dec 1969).

The recovery of point defects in copper after fast-neutron irradiation at 15°K was studied by measurements of residual resistivity. Especially, the effect of deformation on the recovery spectrum before and after low-temperature irradiation was studied. The amount of stage-I recovery was reduced by 20% by deformation after irradiation where the deformation was such that only 2% of atomic planes were swept by dislocations. This result suggests the transformation of some of stage-I defects into more stable ones due to deformation and the fairly large distance between the interstitial and vacancy in a close pair of stage I. Also, the recovery spectra observed in the present experiments seem to show the annealing of interstitial clusters in stage II (≈130°K recovery peak) in cold-worked copper. (auth)

8526 RADIATION DAMAGE IN SELENIUM SINGLE CRYSTALS. Tiainen, O. J. A.; Tunkelo, E. (Technical Univ., Helsinki). Phys. Status Solidi; 36: 567-71(1 Dec 1969).

New radiation damage studies have been performed on a single crystal of trigonal selenium. The conductance and the thermoelectric power of the crystal were measured along the hexagonal c-axis before, during, and after irradiation in a reactor. The temperature range covered in the measurements was 15 to 300°K. The conductivity decreased with increasing fast neutron dose. The thermoelectric power did not change markedly during one irradiation period although a decrease of the thermoelectric power was observed when the crystal was irradiated several times at low temperatures. It seems that a decrease of the hole concentration is not sufficient to explain the conductance at low temperatures. (auth)

8527 ELECTRON SPIN RESONANCE ABSORPTION SPECTRA OF HOLE-TRAP CENTERS ASSOCIATED WITH PHOSPHOROUS IN IRRADIATED SINGLE-CRYSTAL CALCITE. Serway, R. A. (Clarkson Coll. of Tech., Potsdam N. Y.); Marshall, S. A.; Mcmillan, J. A.; Marshall, R. L.; Ohlsen, W. D. J. Chem. Phys.; 51: 4978-82(1 Dec 1969).

An irradiation-produced defect center associated with phosphorous impurities and corresponding to S = ½, I = ½ has been observed in natural single-crystal calcite. Its electron spin resonance absorption spectrum consists of six doublets each exhibiting orthorhombic symmetry with spin-Hamiltonian parameters given by $g_{\xi\xi} = 2.0024$, $g_{\eta\eta} = 2.0382$, $g_{\zeta\zeta} = 2.0090$, $A_{\xi\xi} = -17.25$ MHz, $A_{\eta\eta} = 14.27$ MHz, and $A_{\zeta\zeta} = 17.33$ MHz, where the coordinates ξ, η, and ζ are canted with respect to the calcite crystal coordinates. In addition to providing the nuclear magnetic moment of ^{31}P, ENDOR data were used to determine the signs of the hyperfine splitting tensor components which in turn yield unambiguous values for the Fermi contact term and the traceless

dipole–dipole interaction. On the basis of the small contact term in comparison to the dipole–dipole interaction strength and upon g-value comparisons, it is proposed that the defect center is a CO_3^- molecule ion in close association with a PO_4^{2-} molecule ion, probably mutual charge compensators. The ENDOR spectrum of the PO_4^{2-} molecule ion in calcite was reinvestigated, and the resulting data were used to provide relative signs of the hyperfine structure tensor components. From an analysis of the latter, it is concluded that the unpaired electron spin is localized primarily in an oxygen nonbonding orbital. (auth)

8528 RAMAN SPECTRA OF Cl_2^- HOLE-TYPE CENTERS IN IRRADIATED ALKALI HALIDE–ALKALI BORATE GLASSES. Hass, M.; Griscom, D. L. (Naval Research Lab., Washington, D. C.). J. Chem. Phys.: 51: 5185-6(1 Dec 1969).

The Raman spectrum (488 nm-excited) of 7.5 mole % KCl–22.5 mole % $KO_{\frac{1}{2}}$–70 mole % B_2O_3 glass was observed before and after a γ dose of 7.5×10^6 R. A strong band at 265 cm^{-1} appears after irradiation, with a depolarization ratio of 0.38 ± 0.05. A similar glass with no halide did not undergo any changes in the Raman spectrum after irradiation. The radioinduced Raman band is associated with the hole-type center Cl_2^- molecular ion. (D.L.C.)

8529 SPACE-CHARGE-LIMITED CURRENT IN NEUTRON-IRRADIATED SILICON, WITH EVIDENCE OF THE COMPLETE LAMPERT TRIANGLE. Henderson, H. Thurman; Ashley, K. L. (Southern Methodist Univ., Dallas). Phys. Rev.; 186: 811-15(15 Oct 1969).

A theoretical model proposed by Lampert in 1956 suggests that all single-carrier conduction possibilities in solids, with discrete trapping levels and under constant mobility, are limited within a triangular region on a log-current-versus-log-voltage plot. Lampert's triangle is bounded by Ohm's law, Child's trap-free square law for solids, and an essentially vertical traps-filled-limit line. This paper reports the experimental observation of two of the bounding sides of this triangle, with the theoretically calculated third side fitting the experimental data very well, when based upon measured parameters using two methods of attack. The observations were made on a fast-neutron-irradiated silicon chip with gold-alloy electrodes, at 77°K. The behavior is principally due to the trapping character of the well-known oxygen–vacancy A center, which is activated by the neutron irradiation. (auth)

8530 ELECTRON SPIN RESONANCE IN X-IRRADIATED SODIUM SULPHATE. Hariharan, N.; Sobhanadri, J. (Indian Inst. of Tech., Madras). Mol. Phys.; 17: 507-16(Nov 1969).

Electron spin resonance spectra of x-irradiated single crystals of sodium sulphate were obtained at room temperature and the principal g values of the trapped radicals were calculated. Two of the radical ions exhibited isotropic spectral distribution and were identified as SO_3^- and O_3^-. Two radicals having an anisotropic distribution were identified as SO_2^- and SO_4^-; the observed 90° period for the angular variation of the spectra of these two radicals is attributed to the presence of two inequivalent sites. The spectra taken in the (111) plane support these observations. Sodium hyperfine splitting was observed with the spectrum of SO_4^-. The spectra at liquid nitrogen temperature consisted of two strong isotropic lines attributed to SO_3^- and SO_4^- and a relatively weak anisotropic line due to O_3^-. The experimental results for the group of lines assigned to SO_4^- are fitted to a Hamiltonian $\mathcal{H} = H.g.S + I.A.S$ with $S = \frac{1}{2}$ and $I = \frac{3}{2}$, where g values are 2.0337, 2.0271, and 2.0028 and A values are 26.3, 17.7 and 11.9 MHz. (auth) (UK)

8531 PROPERTIES OF ION-IMPLANTED Bi IN CdS. Tell, B. (Bell Telephone Labs., Inc., Holmdel, N. J.); Gibson, W. M. J. Appl. Phys.: 40: 5320-3(Dec 1969).

It has been reported that room-temperature Bi implants with no post-implantation annealing produce high-conductivity p-type layers in ordinarily n-type CdS. Similarly, Bi and also Xe were implanted into CdS at the 10^{15} cm^{-2} level, and various properties studied, including optical absorption, photoluminescence, and photovoltage. In all cases, similar behavior is observed with both Bi and Xe implants, which indicates that radiation damage effects are dominating any purely chemical effects. (auth)

8532 SPUTTERING OF A SILVER SINGLE CRYSTAL BY ENERGETIC IONS OF ZINC AND CADMIUM. Dey, S. D.; Karmohapatro, S. B. (Saha Inst. of Nuclear Physics, Calcutta). J. Appl. Phys.: 40: 5398-9(Dec 1969).

Sputtering yield measurements were carried out on radioactive Ag single-crystal targets bombarded by normally incident Zn^+ and Cd^+ ions at 5 to 10 keV. The results are compared with these calculated from Onderdelinden's channeling equation. (D.L.C.)

8533 EXCITON MECHANISM FOR CREATING F CENTERS IN HYDROGENATED KCl CRYSTALS. Muradov, S. M.; Muradova, M. Kh.; Yaanson, N. A.; Elango, M. A. (Inst. of Physics and Astronomy, Tartu). Sov. Phys.-Solid State (Engl. Transl.); 11: 1281-4(Dec 1969).

Translated from Fiz. Tverd. Tela; 11: 1582-6(Jun 1969).

An experimental study of the mechanisms involved in generating F centers in KCl:H crystals by x rays has been carried out. It is shown that in these crystals there are at least three processes involved in radiation-induced F centers, of which the fastest takes place by the conversion of U centers to F centers. The characteristics of this process are analogous to those of the optical U → F conversion. It takes place at temperatures greater than 250°K and is not accompanied by the generation of optically active hole color centers. The number of F centers created during this process is proportional to the initial density of U centers in the crystal. The probable mechanism for this process is the decay of exciton-like excitations (HCl)=*, which form either due to the capture of an exciton by the U center or as a result of relaxation by an optically excited U center. (auth)

8534 DEFECT CENTRES IN $KMgF_3$ PRODUCED BY X-IRRADIATION AT ROOM TEMPERATURE. Hall, T. P. P.; Leggeat, A. (Univ. of Essex, Colchester, Eng.). Solid State Commun.; 7: 1657-9(Nov 1969).

Optical and ESR examination of $KMgG_3$ following x irradiation at room temperature showed that the irradiation produces F centers, analogous to those defined for the alkali metal halides, with peak optical absorption at 280 nm and with g value of 2.00 and an isotropic hyperfine structure due to interaction with eight equivalent $I = \frac{1}{2}$ nuclei. Another absorption band, at 440 nm, is tentatively proposed as an M band due to F centers on adjacent sites. Polarization of the emission from this band, which peaks at 566 nm, is consistent with this interpretation. (auth) (UK)

8535 DETECTION OF SINGLE COLLISIONS OF FAST NEUTRONS BY NUCLEATION OF TYNDALL FLOWERS IN ICE. Engelhardt, H.; Mueller-Krumbhaar, H.; Bullemer, B.; Riehl, N. (Technische Hochschule, Munich). J. Appl. Phys.; 40: 5308-11(Dec 1969).

Lattice disturbances have been created in otherwise "perfect" ice single crystals by high-energy neutron irradiation. These imperfections act as nucleation centers for internal melting when ir energy is absorbed. The interaction of a single neutron with the ice lattice is marked by one generated Tyndall flower which can easily be localized. A method is described to grow large single crystals of ice having the low concentration of imperfections necessary for the experiment. A Schlieren optical device with high resolution constructed for the observation of melting figures in the ice crystals is also described. (auth)

8536 THE USE OF PHOTON COUNTING TECHNIQUES FOR THE MEASUREMENT OF RECOMBINATION LUMINESCENCE LIFETIMES. Blair, I. M.; Pooley, D.; Smith, D. (Atomic Energy Research Establishment, Harwell, Eng.). Solid State Commun.; 7: 1615-17(Nov 1969).

A photon-counting technique was used to measure the lifetimes of recombination luminescent transitions in alkali halides. The method, which involves repeated excitation by a pulsed particle beam, was shown to be more accurate than the single pulse analogue method and was used for lifetimes down to 10^{-9} sec. (auth) (UK)

Physical Properties

Refer also to abstracts 8112, 8130, 8133, 8182, and 9079.

8537 STUDY OF THE OPTICAL PROPERTIES OF THIN LAYERS OF YTTRIUM UNDER A STATIC ULTRAVACUUM. Petrakian, Jean-Pierre (CNRS, Marseille). Compt. Rend., Ser. B; 269: 434-7(8 Sep 1969). (In French).

Thin layers of yttrium show an absorption band whose position, in the neighborhood of 5.6 eV, does not depend on their thickness. When the latter increases, a new band appears between 2.5 and 3 eV, the amplitude and position of which vary with it. (tr-auth)

8538 A NOTE ON SPIRAL ORDERING IN hcp RARE EARTH METALS. Harris, R. (Imperial Coll. of Science and Tech., London). Phys. Lett.; 30A: 473-4(15 Dec 1969).

The suggestion of Jackson and Doniach that single band nesting across the {100} zone boundary is associated with the spiral ordering in hcp terbium metal is shown to be quite acceptable. More careful consideration of the RKKY matrix elements shows that even within the usual simple model, there is no factoring out of a structure factor. (auth)

8539 THE SPIN-WAVE DISPERSION RELATIONS AND THE SPIN-WAVE CONTRIBUTION TO THE SPECIFIC HEAT OF

ANTIFERROMAGNETIC UO_2. Cracknell, A. P.; Joshua, S. J. (Univ. of Essex, Eng.). Phys. Status Solidi; 36: 737-45(1 Dec 1969).

The recently measured spin-wave dispersion relations of antiferromagnetic UO_2 were used to calculate the spin-wave contribution to the specific heat of this material as a function of temperature below 20°K. The symmetries of the spin-wave dispersion relations are also discussed. (auth)

8540 ISOCHRONAL ANNEALING OF MOLYBDENUM QUENCHED FROM VARIOUS ATMOSPHERES. Burck, P.; Koethe, A.; Werth, F. R. (Zentralinstitut fuer Festkoerperphysik und Werkstofforschung, Dresden). Phys. Status Solidi; 36: K171-6(1 Dec 1969).

The effects of interstitial impurities on the annealing behavior of electric resistivity in quenched Mo were studied using N_2, O_2, and vacuum as quenching atmospheres with and without a previous carburizing treatment. The C-doped samples show annealing stages at 245, 375, and 610°C. For N-doped samples, the stages are at 130, 205, 300, and 505°C. The D-doped samples have one peak at 830°C, while the vacuum-quenched sample shows one large peak at 420°C and three smaller peaks at 525, 610, and 715°C. The results indicate that the vacancy concentration frozen in is only ~1 ppM. (D.L.C.)

8541 MAGNETOMORPHIC SIZE EFFECT IN TUNGSTEN. Soule, D. E.; Abele, J. C. (Douglas Advanced Research Labs., Huntington Beach, Calif.). Phys. Rev. Lett.; 23: 1287-91(1 Dec 1969).

The magnetomorphic size effect was found in tungsten single crystals. Analytic Fermi-surface models, one of which is calculated here from de Haas–van Alphen results, are analyzed to show that the observed electronic orbital bands originate on the hole octahedron in an inflection region for $\vec{H} \| \langle 100 \rangle$ and in an extended limiting point region for $\langle 111 \rangle$. Preliminary evidence also is discussed for limiting point orbits on the hole ellipsoids. (auth)

8542 STATIC SKIN EFFECT IN TUNGSTEN. Panchenko, O. A.; Lutsishin, P. P. (Inst. of Physics, Kiev). Zh. Eksp. Teor. Fiz.; 57: 1555-60(Nov 1969). (In Russian).

The transverse magnetic resistance of thin single-crystal plates of high-purity tungsten is investigated at 4.2°K in fields up to 10 kOe. The resistivity of thin plates (~0.1 mm) in a magnetic field parallel to the surface is significantly smaller than that in a perpendicular field. It is assumed that the anisotropy observed and related to the shape of the conductor is due to the direct electric current being forced out towards the surface of the plates. In very pure samples, the calculated diffusivity coefficient q is found to depend on the thickness d and is smaller than unity in thin crystals. The observed dependence of q on d is ascribed to the presence in tungsten of small groups of charge carriers which, in principle, are scattered more specularly at the surface than the majority carrier and hence play an appreciable role in the phenomenon. (auth)

8543 ABSORPTION EFFECT IN GRAPHITE. Tamarin, P. V.; Shalyt, S. S.; Volga, V. I. (Inst. of Semiconductors, Leningrad). Sov. Phys.-Solid State (Engl. Transl.); 11: 1399-1400 (Dec 1969).

Translated from Fiz. Tverd. Tela; 11: 1725-7(Jun 1969).

The Nernst effect in pyrolytic graphite heated to 3000 or 3200°C, was studied at 3 to 100°K. Thermo-emf, electric conductivity, thermal conductivity, and magnetic resistance were also measured. The maximum Nernst Q value, at 20°K, is compared with the theoretical value for pure diffusion, and it is concluded that phonon absorption plays a prominent role. (D.L.C.)

Moessbauer Effects and NMR

Refer also to abstracts 7698, 7699, and 8418.

8544 DETERMINING POLAR ANGLES FROM MOESSBAUER INTENSITY RATIOS. Violet, C. E. (Univ. of California, Livermore). J. Appl. Phys.; 40: 4959-61(Nov 1969).

Polar angles cannot be determined in general from intensity ratios of Moessbauer hyperfine lines. However, conditions can be found that specify the polar angle as either perpendicular or parallel to the Moessbauer photon. (auth)

Theoretical Physics

8545 (AEC-tr-7117) ON THE POSSIBILITY OF AMPLIFYING ELECTROMAGNETIC RADIATION THROUGH THE USE OF AVERAGED HIGH-FREQUENCY FIELD FORCES. Luk'yanchikov, G. S. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translation of report NP-18007. 4p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 46470. (M.O.W.)

8546 (IAE-1791) COMPARATIVE EFFECTIVENESS OF VARIOUS CRITERIA IN THE MONTE-CARLO METHOD. Maiorov, L. V.; Frank-Kamenetskii, A. D. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1969. 100p. (In Russian). Dep. CFSTI (U. S. Sales Only).

General equations are obtained for the dispersion of certain estimates used in solving problems of radiation transport by the Monte-Carlo method. Also obtained are approximate velocity coherent equations which permit evaluation of errors in calculating flow with the aid of various criteria. Curves are given for comparison of criteria and selection of the optimum one in each specific case. (auth)

8547 NEW FORMULATION OF STOCHASTIC THEORY AND QUANTUM MECHANICS, IV. THE TWO-PARTICLE SYSTEM. de la Pena-Auerbach, Luis; Cetto, A. M. (Univ. Nacional de Mexico, Mexico City). Rev. Mex. Fis.; 18: 323-46(1969).

The purpose of this paper is to show that the quantum stochastic theory covers the two-body (and in general, the N-body) problem. The method shows that the two particles interact with each other, even when the external classical interaction is assumed to be zero. The independent two-particle model is discussed from the stochastic point of view; in this form, well-known results are recovered, and other interesting ones are obtained about the interaction between particles. (auth)

8548 PROBABILISTIC METHODS IN APPLIED MATHEMATICS. VOLUME I. Bharucha-Reid, A. T. (ed.). New York, Academic Press Inc., 1968. 300p. $15.00; 140s.

Separate abstracts were prepared for two of the three articles. One article, "Random Eigenvalues Problems," by William E. Boyce was not considered in scope for NSA. (M.O.W.)

For abstracts of individual sections see: 8493 and 8826.

8549 ISSLEDOVANIYA PO KVANTOVOI TEORII SISTEM MNOGIKH CHASTITS. (Studies of Quantum Theory of Multi-Particle Systems). Moskalenko, V. A. Kishinev, USSR, Institute of Mathematics and Computer Center, 1969. 79p.

Eleven papers are included. Separate abstracts were prepared for eight. The papers not covered were: Symmetry Groups of High-Spin Systems; Scattering in Degenerate n-Type Semiconductors; and Energy of the Ground State of n-Type Impurity Centers. (M.H.R.)

For abstracts of individual papers see: 8407–8411, 8413, 8414, and 8944.

8550 BROWNIAN MOVEMENT OF HEAVY, MASSIVE-VOLUME PARTICLES IN A DILUTE GAS. Maass, Wolfgang (Univ., Marburg, Ger.). Z. Naturforsch.; 24a: 1575-80(Oct 1969). (In German).

Starting from a master equation for a physical system consisting of mutually noninteracting Brownian particles in a dilute gas and using the collision model of hard spheres a coupled system of equations of motion was obtained for the Brownian distribution function F(R,V; t) and the (single-particle) distribution function f(r,v; t) of the gas. For these equations, assumed to form a "dynamical system", an "H Theorem" yields asymptotic Lyapunov stability in the large relative to total (Maxwell) equilibrium ("tendency to equilibrium"). For example, one investigates approximately the system influenced initially by a sound field (phenomenological coefficients of the equation for F, Fokker–Planck approximation, and BGK model for the f equation). (auth)

8551 CALCULATION OF THE FIELD EMISSION CURRENT OF RELATIVISTIC ELECTRONS RESTRICTED BY A SPACE CHARGE. Godyak, V. A.; Dubovoi, L. V.; Zablotskaya, G. R. Zh. Eksp. Teor. Fiz.; 57: 1795-8(Nov 1969). (In Russian).

The field emission currents from metallic surfaces are calculated by taking into account the space charge effect and relativity of the electrons. Maximal values of the field emission currents for energies between 0.5 and 50 MeV are obtained for tungsten by computer calculations based on the Fowler–Nordheim law and the Poisson equation. It is shown that the maximum current flowing from a needle autoelectron emitter is much smaller than the current calculated recently by a number of authors without taking into account the relativity of the electrons. (auth)

8552 IN HONOR OF PHILIP M. MORSE. Feshbach, Herman; Ingard, K. Uno (eds.). Cambridge, Mass.; Massachusetts Institute of Technology Press (1969). 307p. $20.00.

Separate abstracts were prepared for the six sections considered in scope for NSA. (M.O.W.)

For abstracts of individual sections see: 8365, 8499, 8663, 8677, 8724, and 8736.

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 8580.

Electromagnetic

8553 (COO-1195-173) COMMENTS ON THE LETTER "EVIDENCE OF QUARKS IN AIR-SHOWER CORES". Frauenfelder, Hans; Kruse, U. E.; Sard, R. D. (Illinois Univ., Urbana, Dept. of Physics). Nov 1969. 9p Dep. CFSTI.

The "quark tracks," observed by McCusker and coworkers in cloud chambers can be explained by making reasonable assumptions about two processes: fluctuations in the number of droplets in a cloud chamber track, and the relativistic rise of the ionization. However, before a firm conclusion can be drawn, more experimental data on the drop count distribution of a large sample of tracks in the experiment are needed. (auth)

8554 (DESY-69/34) NEUTRON FORM FACTORS FROM QUASI-ELASTIC e-d SCATTERING. Bartel, W.; Buesser, F.-W.; Dix, W.-R.; (and others) (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Sep 1969. 11p. Dep. CFSTI (U. S. Sales Only).

The reaction $e + d \rightarrow e' + n + p$ was studied at electron scattering angles $\vartheta \leq 35°$ for four-momentum transfers of 0.39, 0.565 and 0.78 $(GeV/c)^2$. By recording electron-neutron and electron-proton coincidences, the ratio of the electron scattering cross sections on quasi-free neutrons and protons was determined. An estimate of the binding effects, based on a Chew–Low-extrapolation, was made. Values for the neutron form factors were derived. (auth)

8555 PROPOSED EXPERIMENTAL TEST FOR THE MASS SHIFT AND THE PECULIAR MOTION OF AN ELECTRON IN A LASER BEAM. Chan, Yau W. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Lett.; 23: 1411-12(15 Dec 1969).

Using the technique of an electron beam crossing a laser beam, an experiment is proposed not only for resolving the controversy of the electron mass-shift effect, but also for confirming the peculiar longitudinal and transverse motion of an electron in an electromagnetic traveling wave. (auth)

8556 SEARCH FOR S = +1 BARYON STATES IN PHOTOPRODUCTION. Mori, S.; Greenberg, J. S.; Hughes, V. W.; Lu, D. C.; Minehart, R. C.; Rothberg, J. E.; Thompson, P. A.; Tyson, J. (Yale Univ., New Haven). Phys. Rev.; 185: 1687-1701(25 Sep 1969).

A search was carried out for S = +1 baryon states (Z particles) in photoproduction on hydrogen with a missing-mass spectrometer by analyzing the structure in the K^- yield as a function of end-point bremsstrahlung energy for fixed laboratory production angles and momentum. Data were taken at the three laboratory angles θ_K = 10°, 15°, and 20° to check the predictable kinematic behavior of two-body final-state reactions. The synchrotron energy was varied from 3.5 to 6.0 BeV, which corresponds to a missing-mass range of 1.6 to 2.5 BeV for a laboratory momentum of 2.5 BeV/c. A fit to the excitation function at $\theta_K = 10°$ suggests structure in addition to a smooth background, while the $\theta_K = 15°$ data can be adequately fitted with a smooth background alone. Upper limits for photoproduction cross sections for each S = +1 state at $\theta_K = 10°$ and 15° are, respectively, 20 and 4 nb/sr in the center-of-mass system. (auth)

8557 PHOTOPRODUCTION OF ρ-MESONS AND OTHER PION PAIRS. McClellan, G.; Mistry, N.; Mostek, P.; Ogren, H.; Silverman, A.; Swartz, J.; Talman, R. (Cornell Univ., Ithaca, N. Y.). Lect. Theor. Phys.; 11-A: 47-63(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

The first results from the Cornell 10-GeV electron synchrotron experiment on ρ^0 photoproduction on carbon, copper, and tin at 6 GeV are reported. The momentum-transfer squared dependence and the A dependence of the cross sections are shown with optical model fits. (L.B.S.)

Weak

Refer also to abstracts 8835 and 8892.

8558 (NEVIS-178) TESTS OF THE ONE PHOTON EXCHANGE MODEL FOR HIGH ENERGY MUON-PROTON ELASTIC SCATTERING. Kramer, Martin A. (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Labs.). 1969. Contract AT(30-1)-1932. 83p. (CU-282; R-691). Dep. CFSTI.

Thesis.

An experiment was performed to study muon-proton elastic scattering at momentum transfers of 0.15 to 0.85 $(GeV/c)^2$. Cross sections were measured for negative muons at 6, 11, and 17 GeV and positive muons at 6 and 11 GeV. A four-foot long liquid hydrogen target was exposed to about 4.5×10^9 muons in each beam, resulting in a sample of about 2000 events for each momentum and sign. The data provide sensitive tests of the currently accepted one-photon exchange model of lepton-proton scattering first proposed by Rosenbluth. Previous tests of this theory (all made using electron–proton results) are extended to higher energies and smaller scattering angles. Since this is the first test of this theory as applied to muons, this is also a test of μ-e universality. The results confirm the predicted linearity of the Rosenbluth plot and the equality of the cross sections of positive and negative muons. Limits are placed on possible deviations of the cross sections from the theory of 2% at $q^2 = 0.175$ $(GeV/c)^2$ and 20% at $q^2 = 0.825$ $(GeV/c)^2$. There is now experimental justification for using the Rosenbluth formula to extract form factors from these data. (auth)

8559 ELECTRON ANTINEUTRINO INTERACTION WITH DEUTERONS. Jenkins, T. L. (Case Western Reserve Univ., Cleveland); Kinard, F. E.; Reines, F. Phys. Rev.; 185: 1599-1606(25 Sep 1969).

The reaction $d(\bar{\nu}_e, e^+)2n$ was observed using antineutrinos from a powerful fission reactor. The measured cross section $\bar{\sigma}_{expt} = 3.0 \pm 1.5 \times 10^{-45}$ cm^2/fission $\bar{\nu}_e$ is consistent with expectations, $\bar{\sigma}_{theor} = 2.4 \pm 0.4 \times 10^{-45}$ cm^2/fission $\bar{\nu}_e$, based on the two-component neutrino theory and elementary considerations regarding the structure of the deuteron. (auth)

8560 PRECISE MEASUREMENT OF THE K^+/K^- LIFETIME RATIO. Lobkowicz, F. (Univ. of Rochester, N. Y.); Melissinos, A. C.; Nagashima, Y.; Tewksbury, S.; von Briesen, H. Jr.; Fox, J. D. Phys. Rev.; 185: 1676-87(25 Sep 1969).

The details of a previously reported precise measurement of the K^+/K^- lifetime ratio are described. Using a separated beam at the Brookhaven AGS, the fractions of 1.6- and 2.0-GeV/c K mesons surviving at distances up to 2000 in. were counted. The result of the measurement yields $\tau(K^+)/\tau(K^-) - 1 = -0.00090 \pm 0.00078$, indicating no violation of the CPT theorem. No evidence for deviations from an exponential decay law or for the existence of long-lived K mesons was found. The upper limit for any long-lived K mesons in the beam is 3×10^{-3} at the 90% confidence level. (auth)

Strong (Baryon-Induced)

8561 (N-69-37606) EVIDENCE FOR THE EXISTENCE OF NEW PROCESSES AT ENERGIES ABOVE 2×10^{11} eV. Kaufman, L.; Mongan, T. R. (Bellcomm, Inc., Washington, D. C.). 10 Sep 1969. Contract NASw-417. 35p. (NASA-CR-105923; TR-69-103-7-3). CFSTI.

A cosmic ray flux measurement in the energy region 10^{10} to 10^{14} eV was obtained by calorimeters on the satellites. Protons I and II, have shown results that are at variance with previous data. While a single power law provides an approximate fit to the all-particle spectrum, the primary proton flux falls sharply at energies above 5×10^{11} eV, indicating that at high energies protons become progressively scarcer in the primary flux. The cross section for particle production of protons on carbon is found to rise by 20% in the interval between 2×10^{10} and 10^{12} eV. The satellite flux measurements are explained by an energy loss mechanism in the calorimeter, with the loss being a function of the energy per nucleon, rather than total energy. Furthermore, this X process has a cross section of the right magnitude to account for the p-carbon cross section measurements. The X process could be described in terms of particle production or dissociation of the primary protons. (auth)

8562 π^+ MESON PRODUCTION IN pp INTERACTION AT 660 MeV. Batusov, Yu. A.; Kostanashvili, N. I.; Lebedevich, G. I.; Nabichvrishvili, D. S.; Yarba, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 10: 805-11 (Oct 1969). (In Russian).

Energy spectra and angular distributions of π^+ mesons produced in pp interactions at 660 MeV, are measured. Experimental results of the reaction $pp \rightarrow d\pi^+$ are in agreement with previous data

and show a noticeable contribution of the F wave proton interaction in the initial state. The dependence of isotropic and anisotropic parts of differential cross section of the reaction $pp \rightarrow pn\pi^+$ on the energy of π^+ mesons in c.m.s. at 55 to 135 MeV, is obtained. The increase of anisotropy in the pion angular distribution with the energy is not seen that is in disagreement with predictions of the Mandelstam model. (auth)

8563 EVIDENCE FOR A NARROW (<20 MeV) RESONANCE AT 530 MeV DECAYING INTO $\pi^+\pi^-$. Kalogeropoulos, T. E. (Syracuse Univ.). Phys. Rev.; 185: 2030-1(25 Sep 1969).

Attention is brought to a statistically significant (~5σ) one-bin (20 MeV) enhancement in the $\pi^+\pi^-$ invariant-mass combinations which is present in two independent experiments on the $2\pi^-2\pi^+$ annihilations at rest. It is shown that the peak is not due to kinematical reflections from other reactions. Suggestions are made for further clarification of this peak. (auth)

8564 NUCLEON–NUCLEON SCATTERING. MacGregor, Malcolm H. (Univ. of California, Livermore). Phys. Today; 22: No. 12, 21-8(Dec 1969).

A review is given for nucleon–nucleon intermediate-energy interactions. The review covers the early history, observed spin and isospin dependence, nucleon–nucleon amplitudes, phase shift analyses, and early phase-shift results. Also, recent elastic and inelastic scattering studies, theoretical implications, further research, and the field of intermediate-energy elementary-particle physics are discussed. (J.F.P.)

8565 DEEPLY INELASTIC PROTON–PROTON COLLISIONS. Marmer, G. J. (Argonne National Lab., Ill.); Ratner, L. G.; Day, J. L.; Johnson, N. P.; Kalbaci, P.; Krisch, A. D.; Marshak, M. L.; Randolph, J. K. Phys. Rev. Lett.; 23: 1469-71(22 Dec 1969).

The differential cross section was measured for 12.4-GeV/c proton-proton inelastic scattering on circles of fixed energy loss in the cm system. The inelasticity was varied from 8 to 94% and covered much of the angular range. For essentially all inelasticities the dependence on $P_\perp^2$ is approximately $e^{-3P_\perp^2}$. The absolute value of $d^2\sigma/d\Omega dp$ also depends only weakly on energy loss. (auth)

Strong (Meson-Induced)

Refer also to abstract 8831.

8566 (COO–1195-172) Ξ^- PRODUCTION IN 5.5 GeV/c K^-p INTERACTIONS. Goldwasser, E. L.; Schultz, P. F. (Illinois Univ., Urbana. Dept. of Physics). 29 Oct 1969. 24p. Dep. CFSTI.

Final states with a Ξ^- hyperon were studied in 5.5-GeV/c K^-p interactions. Center-of-mass production angular distributions for the Ξ^- have a peak in the beam direction while those for the K^+ or K^0 meson peak in the opposite direction. Approximately half of the observed events involve the $\Xi^*(1530)$ or $K^*(890)$ resonances. The four- and five-body final states show production of the $\Xi^*(1930)$ in the $\Xi^-\pi^{+,0}$ mass spectrum and a narrow peak at 2295 MeV in the $\Xi^-\pi^+\pi^-$ mass spectrum. The mass of the Ξ^- hyperon is 1321.9 ± 0.5 MeV as determined from 195 Ξ^- decays with a visible Λ decay. (auth)

8567 (UCRL–19349) GAMMA-SPECTRA FROM RADIATIVE PION CAPTURE IN CARBON. Bistirlich, James A.; Crowe, Kenneth M.; Parsons, Anthony S. L.; Skarek, Paul; Truoel, Peter (California Univ., Berkeley. Lawrence Radiation Lab.). Aug 1969. Contract W-7405-eng-48. 7p. (CONF-690914-5). Dep. CFSTI.

From 3rd International Conference on High Energy Physics and Nuclear Structure, New York.

An experiment to study radiative capture of mesons (π^-) on nuclei is described. The pair spectrometer study of the photon spectrum from hydrogen and carbon is shown, and the rates are given for ^{4}He, ^{6}Li, ^{12}C, ^{16}O, ^{24}Mg, and ^{40}Ca. (J.F.P.)

8568 (UCRL–19359) K^--NEUTRON ELASTIC SCATTERING FROM $K^-d \rightarrow K^-d$ AND $K^-d \rightarrow K^-pn$ AT 1 GeV/c. Jew, Nathan Nay Shew (California Univ., Berkeley. Lawrence Radiation Lab.). Oct. 1969. Contract W-7405-eng-48. 105p. Dep. CFSTI.

Thesis.

Experimental angular distributions for $K^-d \rightarrow K^-d$ and $K^-d \rightarrow K^-pn$ at incident K^- momenta of 810, 910, 1010, and 1110 MeV/c are presented. These distributions are analyzed simultaneously in terms of free nucleon scattering parameters, using Glauber's impact parameter formalism as a starting point. This formalism was modified to make it applicable to the data, which contained a proton momentum cut made during scanning. In addition, two other modifications to this formalism are incorporated into the analysis. One of these arose from the difference in flux factors between K^-d and K^--nucleon scattering, the other from the smearing of the nucleon cross-sections due to Fermi momentum. Finally, this formalism was extended to include spin dependence. The method of analysis required both the K^-p and K^-n elastic scattering amplitudes. The K^-p amplitudes were input from two models based on experiment. These were held fixed during the fitting. Then the K^-n amplitudes were parametrized and the data fitted by varying the K^-n parameters to get a minimum for the fitting χ^2. The analysis included both the single and double scattering effects. (auth)

8569 INVESTIGATION OF $\pi^+\pi^+$ INTERACTION AT LOW ENERGY OF THE DIPION STATE. Aref'ev, A. V.; Bayukov, Yu. D.; Zaitsev, Yu. M.; Kozodaev, M. S.; Kuleshov, V. A.; Leksin, G. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 10: 797-804(Oct. 1969). (In Russian).

Reaction $\pi^+ + p \rightarrow \pi^+ + \pi^+ + n$ is investigated at the initial π^+-meson momentum of 720 MeV/c in the region of small momentum transfers. The $\pi^+\pi^+$-scattering cross sections at low pion energies are obtained using the Chew–Low method in the physical region and extrapolating to the pole. The obtained results are discussed and compared with all the other known data. The sign of the $\pi^+\pi^+$-scattering amplitude is obtained in the effective range approximation. (auth)

8570 BOSON RESONANCE PRODUCTION IN π^-p COLLISIONS AT 11 GeV/c. Caso, C. (Istituto di Fisica and Sezione INFN, Milan); Conte, F.; Tomasini, G.; (and others). Lect. Theor. Phys.; 11-A: 695-716(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

An analysis is made of 2π, 3π, and 4π resonances produced in π^-p interactions at 11 GeV/c. The following boson resonances are detected: ρ^0, f^0, $g^0(2\pi)$, μ, ω, A_1, A_2, A_3, B, $G^-(4\pi)$. Cross sections, decay branching ratios, and mass distributions are presented. (L.B.S.)

Particle Interactions and Properties (Theoretical)

8571 ELEMENTARY PARTICLE PHYSICS. PART II. Eleventh Boulder Summer Institute for Theoretical Physics, Boulder, Colorado, June 17–August 23, 1968. Mahanthappa, Kalyana T.; Brittin, Wesley E.; Barut, Asim O. (eds.). Lectures in Theoretical Physics. Volume XI-A. New York; Gordon and Breach, Science Publishers, Inc. (1969). 376p. (CONF-680627-(Pt.2)).

Eighteen papers are included. Separate abstracts are prepared for seventeen. One paper was previously abstracted for NSA; see NSA 22: 48223. (L.B.S.)

For abstracts of individual papers see: 8570, 8615, 8626, 8639, 8640, 8657–8659, 8675, 8692–8696, 8717, 8718, and 8749.

General

Refer also to abstract 8706.

8572 (AD–687147) RESEARCH ON ELEMENTARY PARTICLES. Final Report, August 1966–November 1968. Salam, Abdus; Matthews, Paul T. (Imperial Coll. of Science and Technology, London (England). Dept. of Physics). 20 Jan 1969. 17p. (AFOSR-69-1153-TR). CFSTI.

The research described extends over a broad range of topics in the theory of elementary particles and related fields, especially concerned with space-time and internal symmetries, current algebras and Regge-pole theory. (auth)

8573 (ITF–69-53) SYSTEMATIZATION OF ELEMENTARY PARTICLES AND CONSIDERATIONS OF THE FOUNDATIONS OF THE FUTURE THEORY. Gerlovin, I. L. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1969. 52p. (In Russian). Dep. CFSTI (U. S. Sales Only).

A method of complete systematization of elementary particles is described. Within this systematization there were obtained formulas for the theoretical calculation of parameters of all the particles, such as masses, charges, spins, magnetic moments, interaction constants and other parameters. The dimensionless spectra of particle parameters are derived from one "fundamental quantum number." Values of this number are determined as parameters resulting in solutions of one equation. Thus, neither arbitrary value nor value taken from experiment are used in the calculation formulas. Only two world constants ħ and C were used in calculations but only as scale units. The coincidence of calculated values with the observed ones is complete. However, the theory predicts the existence of many undiscovered particles

within very high-energy region as well as within relatively low-energy region. The latter can be an object for discussion. The particle systematization was obtained on the basis of the formulation of the unified theory of a new "fundamental field." The bases contain many extremely discussional statements, that is, by trying to keep them in a final elementary particle theory, the possibility of obtaining such systematization on the basis of other physical concepts is not rejected. (auth)

8574 FIELD-CURRENT IDENTITIES, ALGEBRA OF GAUGE FIELDS, AND SPECTRAL-FUNCTION SUM RULES. Kang, Kyungsik (Brown Univ., Providence). New Phys. (S. Korea), Suppl.; 9: No. 1, 85-98(Nov 1969). (NYO-2262TA-213).

A review of field-current identities and spectral-function sum rules in gauge field algebra is presented. The review covers the Gell-Mann and Levy method for currents, the Yang-Mill theory and field-current identity, gauge-field algebra, broken symmetries and mixing models, the Schwinger term, spectral-function sum rules, extension to SU(3) × SU(3). (J.F.P.)

8575 EXISTENCE OF THE FIREBALLS. Daibog, E. I.; Rozental, I. L. (Inst. of Cosmic Research, Moscow). Yadern. Fiz.; 10: 818-21(Oct 1969). (In Russian).

Two-bump shape of the angular distribution of secondary particles produced in multiple processes is the main evidence in favor of the existence of fireballs at energies $\gtrsim 10^{12}$ eV. Analysis of reasons for the two-bump structure from theoretical models (mainly, of the multiperipheral type) is developed further. Contrary to the existing point of view, it is shown that such models must result in the two-bump structure of the angular distribution. (auth)

8576 CLASSICAL RELATIVISTIC ROTATOR AS A BASIS FOR THE ELEMENTARY PARTICLES. Rafanelli, Kenneth Cleveland State Univ.). Phys. Rev.; 185: 1670-5(25 Sep 1969).

A classical Lorentz-covariant generalization of the nonrelativistic theory of a free, stationary, symmetric top is developed. The resulting relativistic theory predicts a physical mass which is a monotonically increasing function of spin asymptotically approaching a linear relation in the limit of large spin. The theory is free of spacelike solutions. (auth)

8577 RESULTS ON ASYMPTOTIC SUM RULES AT INFINITE MOMENTUM. Lu, Eugene Y. C. (Ohio State Univ., Columbus). Phys. Rev.; 185: 1835-7(25 Sep 1969).

An alternative method for obtaining Bjorken's asymptotic sum rules in the limit $k_0 \to \infty$, $P_z \to \infty$ is described. New sum rules valid in the limit $k_0 \to \infty$, $\Delta_z \to \infty$ are obtained and discussed. The existence of an almost-equal-time commutator is proved in Sugawara's theory of currents. (auth)

8578 COVARIANT PHASE-SPACE CALCULATIONS OF n-BODY DECAY AND PRODUCTION PROCESSES. Kumar, Rajendra (Univ. of Delhi). Phys. Rev.; 185: 1865-75(25 Sep 1969).

Lorentz-invariant phase-space integrals for decay and production processes involving n particles in the final state—with integrand containing arbitrary invariant functions of momenta of particles—are transformed into simple definite integrals over Mandelstam-like variables. Given the T-matrix element squared as a function of scalar products of initial- and final-state particle momenta, the results may be used for the computation of the production cross section, decay rate, energy and momentum spectra, invariant mass spectra, and angular correlations. (auth)

8579 ELEMENTARY PARTICLE PHYSICS. PART I. Eleventh Boulder Summer Institute for Theoretical Physics, Boulder, Colorado, June 17-August 23, 1968. Mahanthappa, Kalyana T.; Brittin, Wesley E.; Barut, Asim O. (eds.). Lectures in Theoretical Physics. Volume XI-A. New York; Gordon and Breach, Science Publishers, Inc. (1969). 646p. (CONF-680627-(Pt. 1)).

Thirty-three papers are included in Volume XI-A, Part I, of the Lectures in Theoretical Physics from the Proceedings of the Fifth Boulder Conference on Particle Physics; a separate abstract was prepared for each paper. (L.B.S.)

For abstracts of individual papers see: 8557, 8600-8606, 8614, 8635-8638, 8641, 8656, 8660, 8661, 8686, 8687, 8697-8699, 8701, 8702, 8704, 8715, 8716, 8719-8721, and 8750-8752.

8580 HIGH ENERGY PHYSICS INDEX. VOLUME 7, NOS. 21-22, 1969. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1969). 116p.

Electromagnetic

Refer also to abstracts 8643, 8645, and 8852.

8581 (CERN-Trans-68-14) PHENOMENOLOGICAL ANALYSIS OF PHOTOPRODUCTION OF CHARGED PIONS ON NUCLEONS IN RANGE OF ENERGIES NEAR THRESHOLD. Adamovich, M. I.; Larionova, V. G.; Kharlamov, S. P.; Yagudina, F. R. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translated by F. Quanquin (CERN, Geneva, Switzerland), from Preprint No. 108. 24p. (In French). Dep. CFSTI (U. S. Sales Only).

Starting from experimental data, the energy dependence of the electric dipole amplitude E_0 and the combination of the amplitudes of the waves $P\Delta = (M_1^+ - M_1^- + 3E_1^+)$ for the mesons (π^+) and (π^-) are determined. The isotopic components $E_{0+}^{(0)}$, $E_{0+}^{(-)}$, $\Delta^{(0)}$, $\Delta^{(-)}$ are obtained. Experiments on linearly polarized photons allow the determination of the value $(2M_{1+} + M_{1-})$ for two values of the photon energy E_γ = 210 and 225 MeV. From the threshold values of the amplitudes E_0 (π^+) and E_0 (π^-) estimates are derived for the πN interaction constant and for the difference of πN scattering lengths S in the isotopic spin ½ or ⅔ states. These latter results are examined in conjunction with the estimates obtained from πN scattering. (tr-auth)

8582 (DESY-69/41) VECTOR MESON DOMINANCE AND PHOTOPRODUCTION OF PSEUDOSCALAR MESONS. Schildknecht, D. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Oct 1969. 40p. (CONF-690930-1). Dep. CFSTI (U. S. Sales Only).

From International Seminar on Vector Mesons and Electromagnetic Interactions, Dubna, USSR.

A review of the vector dominance model for photoproduction of pseudoscalar mesons is presented. This review covers the vector dominance model of photoproduction and electroproduction including the field-current identity, the transverse amplitude, the mass-extrapolation assumption, and the s-channel helicity frame; and the application of the vector dominance model to photoproduction of pseudoscalar mesons including mesons (π^+), (π^-), and (π^0) production, $\pi^-\Delta^{2+}$ and $\pi^+\Delta^-$ production, and meson (η) production. (J.F.P.)

8583 (DESY-69/43) ON THE PION FORM FACTOR ON THE BETHE-SALPETER MODEL. Fleischer, J.; Gutbrod, F. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Oct 1969. 17p. Dep. CFSTI (U. S. Sales Only).

A Bethe-Salpeter model is presented, in which phenomenological potentials are used to reproduce the ρ peak in the $\pi\pi$ scattering amplitude. Then the off shell amplitude is taken to calculate the pion electromagnetic form factor. The Bethe-Salpeter equation is used in the ladder approximation and solved by iteration and application of the Padé approximation method. Reasonable agreement with the vector dominance model is achieved. (auth)

8584 NUCLEON STRUCTURE AND VACUUM POLARIZATION. Best, B. G. W.; Kim, D. Y. (Univ. of Saskatchewan, Regina). New Phys. (S. Korea), Suppl.; 9: No. 1, 53-66(Nov 1969).

The effect of the electromagnetic structure of the proton upon the vacuum polarization in mesonic atoms is determined. (auth)

8585 ASYMPTOTIC BEHAVIOR OF FORM FACTORS AND POSSIBLE FREE-FIELD BEHAVIOR FOR THE ELECTROMAGNETIC CURRENT. Gounaris, G. J. (Univ. of Chicago). Phys. Rev.; 185: 1725-30(25 Sep 1969).

It is shown that the assumption that the electromagnetic current behaves at infinity like a free vector-meson field implies that elastic form factors should vanish at infinity faster than would have been expected from vector-meson dominance (VMD). In fact, it is shown that VMD for form factors at infinite momentum transfer is violated with increasing strength as the spin of the particle concerned increases. Under some further speculative assumptions, correlations between the mass spectrum of very heavy particles and the asymptotic behavior of their form factors are found. (auth)

8586 GAUGE INVARIANCE AND REGGE-POLE THEORY IN COMPTON SCATTERING. Ebata, T. (Tokyo Univ. Ames Lab., Iowa); Lassila, K. E. Phys. Rev.; 185: 1717-22(25 Sep 1969).

The kinematics of Compton scattering by a boson target are studied. It is shown that a special interpretation of gauge invariance follows as a requirement of Lorentz invariance of S-matrix elements in the limit of zero photon mass. As a consequence, it is demonstrated that the Pomeranchuk trajectory can contribute to the forward-Compton-scattering amplitude without introducing a singular Regge residue function, in contrast with results obtained via the conventional formulation. The close correspondence with perturbation theory (not required a priori) is also discussed. It is found, however, that a similar treatment of gauge invariance for the Yang-Mills field cannot be given consistently. (auth)

8587 HIGH-ENERGY INELASTIC SCATTERING OF ELECTRONS IN PERTURBATION THEORY. Jackiw, R.; Preparata, G.

(Harvard Univ., Cambridge, Mass.). Contract No. Nonr-1866(55). Phys. Rev.; 185: 1748-53(25 Sep 1969).

It is demonstrated that the cross sections for inelastic scattering of electrons at high energies, when calculated in perturbation theory for various quark models, do not display the experimentally observed behavior. Furthermore, it is shown that the Callan–Gross sum rules, which should hold in quark models, are not satisfied. The reason for this is the breakdown of the Bjorken–Johnson–Low theorem on the high-energy behavior of T products. (auth)

8588 DISPERSION RELATIONS AND CURRENT ALGEBRA FOR THE DECAYS $\eta \to \pi^+\pi^-\gamma$ AND $\rho \to \eta\gamma$. Early, C.; Gupta, K. C. (Univ. of Notre Dame, Ind.). Contract AT(11-1)-427. Phys. Rev.; 185: 2024-6(25 Sep 1969).

Once-subtracted dispersion relations and current commutation relations are used to obtain the physical, hard-pion $\eta \to \pi^+\pi^-\gamma$ decay width in terms of the $\rho \to \eta\gamma$ decay width, thus making a prediction for the latter. (auth)

8589 ASYMPTOTIC VIRTUAL PHOTOABSORPTION CROSS SECTIONS AND SUGAWARA'S THEORY OF CURRENTS. Lu, Eugene Y. C. (Ohio State Univ., Columbus). Phys. Rev.; 185: 1834-5(25 Sep 1969).

Asymptotic bounds on transverse and longitudinal total virtual photoabsorption cross sections at high momentum transfer are obtained in Sugawara's theory of currents. (auth)

8590 AMBIGUOUS MASS AND WIDTH OF THE ρ MESON. Einhorn, Martin B. (Stanford Univ., Calif.). Phys. Rev.; 185: 1969-2(25 Sep 1969).

The relationship between the mass and width of the ρ-meson resonance seen in colliding-beam experiments and the behavior of the $\pi\pi$ scattering phase shift is discussed in detail. Two conclusions are drawn: (1) The resonance peak in e^+e^- annihilation occurs 5 or 10 MeV below the energy where the phase shift reaches $\frac{1}{2}\pi$; (2) the width should not be identified with the slope of the phase shift at one point — in fact, it depends critically on details of the $\pi\pi$ strong interaction over a wide energy range. (auth)

8591 MODEL FOR ELECTROMAGNETIC UNITARITY CORRECTIONS TO FIXED POLES AND HIGH-ENERGY COMPTON SCATTERING. Chung, Victor (City Coll., New York). Phys. Rev.; 185: 1962-9(25 Sep 1969).

Corrections to the linear unitarity approximation of Abarbanel et al. in Reggeizing Compton scattering are made by consideration of weakly coupled photons in the intermediate state of the annihilation channel with the help of a cutoff-dependent Bethe–Salpeter model. This model displays a "weak" trajectory localized near J = 1, and strong-interaction trajectories shifted by quantities of order e^2. The correction to the asymptotic cross section is of the form e^4 lns. (auth)

8592 INELASTIC ELECTRON–PROTON AND γ–PROTON SCATTERING AND THE STRUCTURE OF THE NUCLEON. Bjorken, J. D.; Paschos, E. A. (Stanford Univ., Calif.). Phys. Rev.; 185: 1975-82(25 Sep 1969).

A model for highly inelastic electron–nucleon scattering at high energies is studied and compared with existing data. This model envisages the proton to be composed of pointlike constituents ("partons") from which the electron scatters incoherently. It is proposed that the model be tested by observing γ rays scattered inelastically in a similar way from the nucleon. The magnitude of this inelastic Compton-scattering cross section can be predicted from existing electron-scattering data, indicating that the experiment is feasible, but difficult, at presently available energies. (auth)

8593 DIVERGENT ELECTROMAGNETIC MASSES AND DEEP-INELASTIC ELECTRON–HADRON SCATTERING. Pagels, Heinz (Rockefeller Univ., New York). Phys. Rev.; 185: 1990-2 (25 Sep 1969).

It is shown that the electromagnetic self-energies of the hadrons and the mass splittings are divergent unless there is very special behavior of the electron-hadron scattering amplitude in the deep-inelastic region. Only the validity of the Cottingham formula, a nontrivial Bjorken limit of the scattering-structure functions, and analyticity of a partial-wave amplitude in angular momentum are assumed. (auth)

8594 CUTOFF-INDEPENDENT CHARACTER OF ELECTROMAGNETIC ZERO-POINT FORCES. Boyer, Timothy H. (Univ. of Maryland, College Park). Phys. Rev.; 185: 2039-40 (25 Sep 1969).

The cutoff-independent character of the quantum forces arising from electromagnetic zero-point energy is seen to be dependent upon the vector character of the electromagnetic field. (auth)

8595 QUANTIZED SYNCHROTRON RADIATION IN INTENSE MAGNETIC FIELDS. Chiu, Hong-yee; Fassio-Canuto, Laura (Goddard Space Flight Center, New York). Phys. Rev.; 185: 1614-18(25 Sep 1969).

The radiation rate from de-excitation of electrons in quantized orbits in magnetic fields is computed. Such radiation in the classical limit is known as synchrotron radiation. The radiation properties of electrons in magnetic orbits of low quantum numbers are stressed. (auth)

8596 ELECTRON BREMSSTRAHLUNG IN INTENSE MAGNETIC FIELDS. Canuto, Vittorio; Chiu, Hong-yee; Fassio-Canuto, Laura (Goddard Space Flight Center, New York). Phys. Rev.; 185: 1607-13(25 Sep 1969).

Detailed calculations are presented of the most important radiation process in ponderable matter in the presence of an intense magnetic field: the electron bremsstrahlung. This differs from an ordinary bremsstrahlung process in that in a magnetic field the electrons are one-dimensional particles free to move in the direction of the field, but bound in the plane perpendicular to the magnetic field in quantized circular orbits with energy (in the nonrelativistic limit) in multiples of 11.9×10^{-9}H eV, where H is the magnetic field in gauss. The emission rate and the absorption coefficient were obtained for fields much less than 10^{13} G. This calculation is valid in the large quantum number limit. (auth)

8597 IMPLICATIONS OF THE FINITENESS OF THE ELECTROMAGNETIC SELF-MASS IN ELECTRON–POSITRON ANNIHILATION INTO HADRONS. Das, T. (Tata Inst. of Fundamental Research, Bombay). Phys. Rev.; 185: 1846-7(25 Sep 1969).

The finiteness of the electromagnetic self-masses of hadrons is shown to have some observable consequences, independent of any specific model which achieves it. On very general grounds, following Bjorken's prescription for studying the high-energy behavior of the matrix elements which occur in the expressions for the electromagnetic self-masses, it is shown that if the electromagnetic self-mass of a particular hadron is finite to order α, then $\lim_{W\to\infty} W^6 \ln W \, d\sigma(W,E)/dE = 0$, where $d\sigma(W,E)/dE$ is the differential cross section for e^+e^-, with cm energy W, going into any number of hadrons plus that specific hadron in question with energy E. The relevance of the result to the electron-positron annihilation experiments is also discussed. (auth)

8598 FORM FACTORS AND PHOTOPRODUCTION IN THE $\rho + \rho'$ MODEL. Cordes, J. G.; O'Donnell, P. J. (Univ. of Toronto). Phys. Rev.; 185: 1858-64(25 Sep 1969).

The nucleon isovector form factor $F_1^V(t)$ is described by two isovector resonances, the ρ and the ρ'. The effect of the ρ' resonance on current-algebra sum rules and on the normalization of the pion factor $F_\pi(t)$ is investigated. The widths $\Gamma_{(\rho\to 2\pi)}$ and $\Gamma_{(\rho\to 2l)}$ are determined within fairly narrow limits to be in excellent agreement with a recent analysis of the colliding-beam data. The pion form factor in the spacelike region is found to behave like t^{-1} at large t. Using the γ-ρ' coupling determined by this analysis, a possible explanation is given for the apparent discrepancies reported recently in photoproduction experiments. A discussion of the u = 0, πN superconvergence relations is given. A detailed account of the nucleon form factors $G_E^p(t)$ and $G_E^n(t)$ is presented. (auth)

8599 SUM RULES FROM LOCAL CURRENT ALGEBRA. Gupta, V.; Rajasekaran, G. (Tata Inst. of Fundamental Research, Bombay). Phys. Rev.; 185: 1940-4(25 Sep 1969).

By combining the local current algebra with the commutation relations between the current densities and the Lorentz boost operator, low-energy theorems as well as sum rules are derived which involve neutrino and electron scattering form factors. (auth)

8600 QUARK FIELD ALGEBRA, GAUGE FIELD ALGEBRA AND VECTOR MESON DOMINANCE. Sakurai, J. J. (Univ. of Chicago). Lect. Theor. Phys.; 11-A: 199-211(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

The derivations of commutation relations of quark field algebra are briefly discussed. The differences between the nature of the Schwinger term and the space-space commutation relations in gauge field algebra and quark field algebra are discussed. Several experimental tests of the two algebras are discussed: electron-positron colliding beam cross section, π^0 decay; and inelastic electron-nucleon scattering. (L.B.S.)

8601 SOFT PION SUMMATIONS AND A CHIRAL CANCELLATION. Fried, H. M. (Brown Univ., Providence). Lect. Theor. Phys.; 11-A: 243-56(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

Functional methods used in summations of soft photon physics

are applied to soft pion summations, using the model of soft pion-nucleon interactions. The discussion is concerned with nucleon electromagnetic form factors. General techniques are described, and the resulting absence of virtual soft pion damping is shown along with a tendency for enhancement at large momentum transfer. A complete cancellation of such high energy effects is obtained when both the axial and vector parts of the pion-nucleon interaction are taken into account. It is concluded that without the explicit cancellation, and within the approximations used, soft pions would generate a power law increase of the nucleon form factors with increasing momentum transfer. (L.B.S.)

8602 $SU(6)_W$ AND HIGH ENERGY PHOTOPRODUCTION. Meshkov, Sydney (National Bureau of Standards, Washington, D. C.). Lect. Theor. Phys.; 11-A: 23-37(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

A brief review is first given of $SU(6)_W$ and how it may be used to describe photoproduction amplitudes. Ratios of differential cross sections in the forward direction for $\gamma p \to K^+\Sigma$, $\gamma p \to K^+\Lambda$, and $\gamma p \to \pi^+ n$ interactions at 3 to 18 GeV are calculated using $SU(6)_W$ amplitudes. The predicted ratios of $K^+\Sigma/K^+\Lambda$ are in good agreement with the SLAC experiment. Differential cross sections for forward vector meson production are also calculated using the vector dominance model and $SU(6)_W$ amplitudes. (L.B.S.)

8603 FORWARD PHOTOPRODUCTION OF VECTOR MESONS ON DEUTERIUM. Lebedev, A. I. (Cornell Univ., Ithaca, N. Y.). Lect. Theor. Phys.; 11-A: 39-46(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

It is shown that the vector dominance diffractive model can be used to describe ρ-meson photoproduction on deuterium. The $\gamma + p \to p + \rho^0$, $\gamma + d \to d + \rho^0$ and $\gamma + d \to p + n + \rho^0$ interactions are discussed for high energy photons (>1 GeV) and for small angles of ρ-meson emission ($\theta \approx 0^0$, $\theta < 5^0$). (L.B.S.)

8604 SOLUTIONS TO GELL-MANN–DASHEN ANGULAR CONDITIONS. Chang, Shau-jin (Inst. for Advanced Study, Princeton, N. J.). Lect. Theor. Phys.; 11-A: 287-97(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

A method is given for constructing all the possible solutions to the angular conditions for saturation of current algebra at infinite momentum. All known solutions are first reviewed. Some of the properties of the infinite momentum E(2) basis are discussed. The solutions are then analyzed systematically, and some of their general properties are discussed. (L.B.S.)

8605 DASHEN–GELL-MANN ANGULAR CONDITIONS: DERIVATION, REDUCTION, AND EXISTENCE OF SPACE-LIKE SOLUTIONS. O'Raifeartaigh, L. (Inst. for Advanced Study, Princeton, N. J.). Lect. Theor. Phys.; 11-A: 273-85(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

The Dashen–Gell-Mann angular condition which is imposed on the current to assure that the saturation of current algebra at infinite momentum in Lorentz invariant is derived. The angular condition is reduced to a set of algebraic equations which do not involve the momentum transfer. It is shown that these equations always have space-like solutions. (L.B.S.)

8606 HIGHER ORDER LOW-ENERGY THEOREMS FOR NUCLEON COMPTON SCATTERING. Choudhury, S. Rai (Princeton Univ., N. J.). Lect. Theor. Phys.; 11-A: 455-63(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

The scattering of photons in the low-energy region is considered to second-order in electromagnetic interactions. Expressions are derived for the helicity amplitudes and for the unpolarized differential cross sections. (L.B.S.)

8607 NOTE ON THE ISO-VECTOR PART OF THE NUCLEON ELECTROMAGNETIC FORM FACTORS. Furuichi, Susumu (Rikkyo Univ., Tokyo); Kanada, Hiroyuki; Watanabe, Keiji. Progr. Theor. Phys. (Kyoto); 42: 861-70(Oct 1969).

The isovector part of the nucleon electromagnetic form factors is reinvestigated in order to study the following properties: the difference between the dispersion relations for the Dirac and the Sachs form factors, the asymptotic behaviors of these form factors in large momentum transfer regions, and the stability of results on the variation of parameters which have been predetermined. In the momentum transfer region $0 \geq t > -1$ $(GeV/c)^2$, an excellent agreement is found between experiment and dispersion relations both for the Dirac and the Sachs form factors, for rather widely different values of the ρ-meson width and the cutoff momentum. For the high momentum transfer region it is shown that the Sachs conditions can be satisfied by adding pole terms with the mass of about 1.6 GeV. By this modification a result is also obtained consistent with the $p\bar{p} \to ee$ experiment for the time-like momentum transfer region. (auth)

Weak

Refer also to abstract 8599.

8608 CALCULATION OF PROBABILITY OF $\pi^0 \to e^+ + e^-$ DECAY. Litskevich, I. K.; Franke, V. A. (Leningrad State Univ.). Yadern. Fiz.; 10: 815-17(Oct. 1969). (In Russian).

The branching ratio $r = W(\pi^0 \to e^+ + e^-)/W(\pi^0 \to 2\gamma)$ is calculated on basis of the vector dominance hypothesis. The method used enables one to get a numerical result that does not depend on the arbitrary cut-off parameter arising in the dispersion-relation approach. The result is $r = 1(10)^{-7}$. (auth)

8609 BOSON SPECTRA, F_K/F_π, AND SUM RULES. Matsuda, Seisaku (Polytechnic Inst. of Brooklyn); Oneda, S. Phys. Rev.; 185: 1887-93(25 Sep 1969).

Present experiments on semileptonic decays indicate $F_K/F_\pi \simeq 1.22$. However, in contrast with the apparent success of many other sum rules, asymptotic SU(3) symmetry and chiral SU(3) ⊗ SU(3) algebra tend to predict $F_K = F_\pi$. This problem is studied in the approach which utilizes the SU(3) ⊗ SU(3) charge-charge density algebra and a form of asymptotic SU(3) symmetry called the "SU(3) approximation." This approximation is assumed for the SU(3) raising and lowering operator V_K only in the zero-momentum-transfer limit. It is suggested that the problem may reflect the fact that we have not yet taken into account the full contribution of the boson spectrum. As one of the simplest and most interesting ways of introducing a more complicated boson spectrum, the contribution of the exotic mesons with abnormal charge-conjugation parities is studied. It is shown that the introduction of exotic channels removes the difficulty of $F_K = F_\pi$, while the essential features of other sum rules remain unaffected: The value $F_K/F_\pi \simeq 1.22$ can be obtained in our approach if there exists the $I = \frac{1}{2}\,0^+\kappa$ meson with mass around 1.1 BeV. This value of the κ mass can also be predicted from our intermultiplet mass formulas which are also based on the SU(3) approximation. (auth)

8610 SAKURAI'S WEAK-INTERACTION HAMILTONIAN AND THE K_1^0-K_2^0 MASS DIFFERENCE. Rockmore, Ronald (Technion-Israel Inst. of Tech., Haifa). Phys. Rev.; 185: 1847-8 (25 Sep 1969).

It is shown that Sakurai's effective weak Hamiltonian predicts a mass difference of the neutral kaons, which is both too large in magnitude and of the wrong sign when the weak K_1^0 self-mass is calculated with π-π scattering parameters favored by current algebra. (auth)

8611 FINAL-STATE INTERACTION EFFECTS IN WEAK THREE-BODY DECAYS. Amado, R. D.; Noble, J. V. (Univ. of Pennsylvania, Philadelphia). Phys. Rev.; 185: 1993-2003(25 Sep 1969).

An exactly soluble model of the weak decay of a 0^+ particle to three strongly interacting 0^+ decay products is investigated numerically in order to explore the effects of final-state interactions (FSI) on the decay and the way in which the resonant-pair interaction information is distributed over the three-body final state. It is found that moderately strong attractive pairwise FSI can produce very large enhancements or de-enhancements in the decay rate, but no effect of rescattering singularities is found. It is found that large effects on the decay rate can be accompanied by pure phase-space single-particle spectra. The effects of interference between various terms in the amplitude make the extraction of pair-resonance parameters from singles spectra chancy, and there is no obvious trend in the deviation from the input resonance parameters. These interference effects also produce striking and possibly misleading patterns in the Dalitz plots. (auth)

8612 SU(3) × SU(3) BREAKING, K_{l3} DECAYS, AND THE κ ENHANCEMENT. Auvil, P. R.; Deshpande, N. G. (Northwestern Univ., Evanston, Ill.). Phys. Rev.; 185: 2043-5(25 Sep 1969).

Alternative values of the symmetry-breaking parameters, which are consistent with two reported κ enhancements, are considered within $(3,3^*) \oplus (3^*,3)$ broken SU(3) × SU(3) symmetry; and subsequent predictions are compared with K_{l3}-decay form factors. (auth)

8613 NONLEPTONIC WEAK INTERACTIONS IN A TADPOLE MODEL. Kumar, Rajendra (Univ. of Delhi). Phys. Rev.; 185: 1814-30(25 Sep 1969).

Nonleptonic weak interactions are studied in a tadpole model under the following assumptions: (i) The parity-conserving, strangeness-changing, nonleptonic weak interactions are assumed

to be dominated by the κ_1 tadpole and the amplitudes for the various processes are obtained from the relevant pole diagrams; (ii) the field operator of the κ meson is assumed to be proportional to the divergence of the strangeness-changing vector current; thus, the κ couplings to baryons and mesons are related to vector-current couplings; and (iii) the vector-current couplings are assumed to be unrenormalized, and SU(3) relations are used for Yukawa couplings. An exact cancellation of amplitudes is found to occur in all nonleptonic processes, independent of the masses of particles, the D/F ratios, and the magnitudes of various types of couplings, and of the mixing of unitary-singlet and octet-isosinglet mesons. The processes studied in this paper are (i) mesonic decays of hyperons ($B \to B' + \pi$; $\Omega^- \to \Xi + \pi$, $\Xi^* + \pi$, $\Lambda + K^-$) and pionic decays of K mesons ($K \to 3\pi$); (ii) weak radiative decays of hyperons ($B \to B' + \gamma$, $B \to B' + \pi + \gamma$) and K mesons ($K \to 2\pi + \gamma$, $K \to 3\pi + \gamma$); (iii) nonmesonic, nonleptonic weak processes ($\Lambda + N \to N + N$); and (iv) the K_1^0–K_2^0 mass difference. A comparison is made with Coleman and Glashow's tadpole model and comment is made on the choice of high-spin propagators. (auth)

8614 APPLICATIONS OF CURRENT ALGEBRA TO NUCLEAR NEUTRINO REACTIONS AND TO MUON CAPTURE IN NUCLEI. Ram, Michael (State Univ. of New York, Buffalo). Lect. Theor. Phys.; 11-A: 213-25(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

Some recent applications of the closure approximation and the Gell-Mann algebra of charges to the problem of elastic scattering of neutrinos and antineutrinos are described. Relations among differential cross sections are derived and are applied to the nuclear isospin doublet (^{3}He, ^{3}H). The result of a similar application to muon capture in nuclei is briefly described. (auth)

8615 A PRAGMATIC APPROACH TO NONLEPTONIC WEAK INTERACTIONS. Olesen, P. (Univ. of Rochester, N. Y.). Lect. Theor. Phys.; 11-A: 957-67(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

The effect of higher-order contributions to first-order weak interaction predictions is considered. The following approach is considered—to introduce a weak interaction cutoff Λ, from which the nature of the cutoff and possible predictions for other processes can be obtained from the value of Λ. Two theories are considered: the universal Fermi theory and the vector boson theory. A review is given of the main results obtained so far and some of the derivations. Comments on the pragmatic approach to the weak interactions are given. (L.B.S.)

8616 P-WAVE NONLEPTONIC HYPERON DECAYS AND URBARYON REARRANGEMENT. Katuya, Mituaki (Research Inst. for Fundamental Physics, Kyoto); Murayama, Akihiro. Progr. Theor. Phys. (Kyoto); 42: 980-1(Oct 1969).

Comments are made on the amplitudes of urbaryon rearrangements that lead to the main properties of p-wave nonleptonic hyperon decays. (L.B.S.)

Strong (General)

Refer also to abstract 8745.

8617 (NYO-4076-4) PHENOMENOLOGICAL DUALITY. Kovesi-Domokos, S. (Johns Hopkins Univ., Baltimore, Md. Dept. of Physics). 25 Nov 1969. Contract AT(30-1)-4076. 44p. Dep. CFSTI.

The history and present status of phenomenological duality is summarized. The results and phenomenological justification are considered. Analyticity and Regge behavior for the finite-energy sum rules, the Dolen–Schmid and phenomenological duality, the separation of the Pomeranchuk and the background, and exotic states and exchange degeneracy are discussed. (J.F.P.)

8618 TWO-PARTICLE PROCESSES AT HIGH ENERGIES IN THE OREAR REGION OF THE MOMENTUM TRANSFERS. Anisovich, V. V.; Khrustalev, O. A. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 10: 826-31(Oct 1969). (In Russian).

If at high energies the particle interactions proceed mainly in a peripheral or multiperipheral way, then the two-particle reactions behave like $\exp(-bp_\perp)$ in the Orear region. The constant b has the following properties: it is equal for scattering, charge exchange, backward scattering, and for reactions proceeding in the t channel with exchange of vacuum quantum numbers; for reactions $A + B \to C + D$ with exchange of nonzero quantum numbers in the t channel, $b = \min\{b_{AB\to AB}, b_{CD\to CD}\}$. The properties are compared with the experimental data. (auth)

8619 TO THE THEORY OF DECAYS OF DEGENERATE OR ALMOST DEGENERATE STATES. Kobzarev, I. Yu.; Nikolaev, N. N.; Okun, L. B. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 10: 864-72(Oct 1969). (In Russian).

The formulas which describe systems of several close metastable levels are given. Physical applications of the theory of degenerate unstable states discussed recently are briefly enumerated. It is emphasized that such states can be considered in a simple and unified way as the problem of N levels for the Schrödinger equation with a non-Hermitian effective Hamiltonian. The Breit-Wigner formula generalization for the case of N nonorthogonal unstable states which satisfies the unitarity condition is discussed. Application of usual formulas of the matrix theory allows one to obtain easily and to write in a compact form the results previously known. The simple derivation of these formulas by the projection operator method is given. (auth)

8620 POSITIVITY OF THE ABSORPTIVE PART OF INTERACTION OPERATOR. Malkov, E. I. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz.; 10: 849-55(Oct 1969). (In Russian).

It is shown that the positivity of the absorptive part of an interaction operator arises from the unitarity condition. The result is a number of inequalities. Applications of these inequalities to the case of scattering of two spinless particles are considered. It is shown, in particular, that the derivative of a Regge-pole trajectory at zero momentum transfer cannot vanish. (auth)

8621 SEMI-PHENOMENOLOGICAL ANALYSIS OF SCATTERING AMPLITUDE AT HIGH ENERGIES. Savrin, V. I.; Tyurin, N. E.; Khrustalev, O. A. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 10: 856-63(Oct 1969). (In Russian).

An asymptotic formula expressing the scattering amplitude of identical particles via the contribution of inelastic channels of the reaction at $|t| \ll s$, is obtained. The comparison with the experimental data on proton elastic scattering at high energies is performed. (auth)

8622 EXTENDED LEE MODEL WITH AN ARBITRARY NUMBER OF POSSIBLE BARYON STATES. Nickle, H. H. (Duke Univ., Durham, N. C. Contract No. DA-31-124-AROD-13. Phys. Rev.; 185: 1894-9(25 Sep 1969).

The application of Tomonaga's intermediate-coupling approximation to an extended Lee model in which the single baryon may exist in k possible states is outlined. The intermediate-coupling solution of such a model is shown to be characterized by a class of polynomial functions which are defined by a three-term recurrence relation. The bound states correspond to the zeros of these polynomials, but there is no simple relation between the bound states of the model with k possible baryon states and the next "higher" Lee-type model with k + 1 possible baryon states. Furthermore, an algebraic solution of the problem is not possible for $k \geq 5$, because the order of the secular equation is equal to the value of k. Some specific results are given for the n = 3 sector of the extended Lee-type model with four possible baryon states. It is conjectured that all extended Lee models of this type will exhibit a strong-coupling "isobar" spectrum of the type found by North for the cases of the ordinary Lee model and the Bronzan-Lee model. (auth)

8623 HIGHER-ORDER NONCOMPACT GROUPS AS THE RELATIVISTIC QUARK-MODEL REPRESENTATIONS OF CURRENT ALGEBRA AT INFINITE MOMENTUM. Pavkovic, Marko I. (Tel-Aviv Univ., Israel). Phys. Rev.; 185: 1789-96(25 Sep 1969).

It is suggested that systematic use be made of higher-order noncompact groups in the problem of the relativistic quark-model representations of the current algebra at infinite momentum. The method includes the idea of relying upon one single unitary irreducible representation of G, namely, $SL(2,c) \subset G$, rather than considering infinitely reducible representations of SL(2,c). As an illustration, an idealized quark model is discussed, where the particle states at rest belong to the Hilbert space $d \otimes g$. d denotes the ordinary four-dimensional space of Dirac spinors, while g symbolizes one particular unitary infinite-dimensional irreducible representation of the group SO(4,2). For simplicity, only a totally degenerate mass spectrum is considered, but the trivial mass operator is not typical, and the method can be extended to more realistic quark models with more interesting mass spectra. (auth)

8624 CURRENT ALGEBRA AND REGGE POLES. Yamada, Masao (Univ. of Texas, Austin). Phys. Rev.; 185: 1806-10 (25 Sep 1969).

It is shown that the SU(2) × SU(2) current commutation relations and partial conservation of axial-vector current lead us to ex-

change degeneracy between a number of Regge trajectories—not only for the leading trajectories but for lower-ranking ones. Comparisons with experiments are consistent with all known N and Δ trajectories as well as meson trajectories. (auth)

8625 EXCHANGE DEGENERACY AND SU(3). Capps, Richard H. (Purdue Univ., Lafayette, Ind.). Phys. Rev.; 185: 2008-14(25 Sep 1969).

It is hypothesized that the imaginary parts of the contributions of exchange-degenerate Regge trajectories cancel in hadron-hadron states of internal quantum numbers for which no resonances exist. A recent work by the author on SU(3)-symmetric baryon trajectories in meson-baryon states is generalized to include all trajectories and all meson-meson, meson-baryon, and baryon-baryon states. Consistency is possible for these states. The difficulty concerning baryon-antibaryon states is discussed. The large, observed $\pi\pi$N decay of the $j^P = \frac{3}{2}^-$ $\Delta^*(1670)$ is predicted from the consistency conditions. The magnitude of the coupling to baryons of any singlet meson is predicted in terms of the octet interactions. This result includes the prediction that φNN vertices of all spin dependences vanish. The modification imposed by the baryon exchange-degeneracy hypothesis on the Regge analysis of meson-baryon scattering is discussed. The relation of the results to the bootstrap hypothesis is discussed. (auth)

8626 NEW METHOD TO LIMIT ABUNDANCE OF COSMIC RAY QUARKS. Libby, L. Marshall (Univ. of Colorado, Boulder); Thomas, F. J. Contract AT(11-1)-1537. Lect. Theor. Phys.; 11-A: 697-75(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

A method to set limits on ambient density of cosmic ray quarks is suggested, by non-observation of pathological radioactivity related to fission catalysis in monitored stockpiles of heavy metals. The limit of quark density presently estimated by this method is $N_Q \leq 1.3 \times 10^{-30}$ quarks/nucleon of heavy metal. This limit is equally applicable to any heavy stable negative cosmic ray particle. (auth)

8627 POSSIBLE CHARACTERIZATION OF SHORT-RANGE INTERACTIONS. Finley III, J. D. (Univ. of California, Berkeley). J. Math. Phys. (N. Y.); 10: 2060-6(Nov 1969).

Possible characterizations of "short-range" interactions were previously investigated by means of conditions on the total transition probability $||T\psi||^2$ which were valid only for certain types of sequences of wave packets. The assumption on the transition probability is generalized so that it will apply to an arbitrary wave packet. This is done by utilizing a measure $G[R,\psi]$ of how much of a wave packet ψ is within a sphere of radius R about the scattering center at all times. Then a "short-range" interaction is characterized by the existence of a positive constant A and positive functions B(p) and C(p) such that for all $R \geq 0$, $||T\psi||^2 \leq AG[R,\psi] + \langle C(p)e^{-RB(p)}\rangle_\psi$. It is then shown that for such interactions the square of the scattering amplitude is analytic, in the cosine of the scattering angle, in an ellipse the size of which depends upon B(p). The results are compared with the similar results obtained by the previous method and it is shown that these new results much more closely approximate the behavior of the Yukawa interaction. (auth)

Strong (Baryon No. = 0)

Refer also to abstracts 8588, 8590, 8598, and 8678.

8628 (COO-264-521) MASS DEPENDENCE OF THE DIFFRACTION PEAK IN RESONANCE PRODUCTION AND THE MULTIPOINT VENEZIANO MODEL. Waltz, Ronald E. (Chicago Univ., Ill. Enrico Fermi Inst.). Oct 1969. 12p. (EFI-69-87). Dep. CFSTI.

It is shown that the multipoint Veneziano model predicts that the diffraction peak in resonance production should smoothly broaden as the resonance mass increases in qualitative agreement with experiment. Comparisons with "nondual" models are made. (auth)

8629 (COO-264-525) GENERALIZED VECTOR DOMINANCE THEORY AND VERTEX FUNCTIONS. Frampton, P. H. (Chicago Univ., Ill. Enrico Fermi Inst.). Oct 1969. Contract AT(11-1)-264. 53p. (EFI-69-92). Dep. CFSTI.

A simple model formula for the hadronic form factors as a ratio of two gamma functions is examined from the point of view of its consistency with the beta function model and with the chiral properties of the vector and axial-vector currents. It is shown that similar models may hold simultaneously for the simplest vector and axial-vector form factors while maintaining consistency with the Veneziano model of the four-point function, and with the requirements of a conserved vector current, partially conserved axial-vector current and the Gell-Mann algebra of currents. An infinite class of such solutions is found. Scalar and pseudoscalar form factors are treated also, with similar results. In order to consider matrix elements of the vector and axial-vector current operators between other hadron states generalized field-current identities are written, and a universality hypothesis that the vector mesons ρ and A_1 and their higher recurrences couple universally to the independent helicity amplitudes of the Breit frame is made. As an example a treatment of the nucleon electromagnetic and axial-vector form factors is given leading to simple model formulas for the Sachs form factors $G_E(t)$ and $G_M(t)$, and the axial vector form factor $G_A(t)$, which for spacelike values of t agree very well with the experimental results. (auth)

8630 UNIQUENESS OF THE VENEZIANO REPRESENTATION. Matsuda, Satoshi (California Inst. of Tech., Pasadena). Contract No. AT(11-1)-68. Phys. Rev.; 185: 1811-14(25 Sep 1969).

It is proved that the generalized Veneziano representation, expressed as a sum of terms of the Veneziano type, is the unique dynamical solution for a relativistic scattering amplitude which satisfies analyticity, crossing symmetry, and the specific dynamical assumption of the narrow-resonance approximation with resonances lying on linear trajectories. (auth)

8631 LOW-ENERGY PION–PION SCATTERING IN THE UNITARIZED STRIP APPROXIMATION. Johnson, R. C. (Univ. of Toronto); Collins, P. D. B. Phys. Rev.; 185: 2020-3(25 Sep 1969).

An improved set of parameters is presented for a successful bootstrap of the ρ and Pomeranchon Regge trajectories in pion-pion scattering. The resulting π-π amplitudes are compared with the experimental data, with particular reference to the low-energy S-wave phase shifts, which agree fairly well with present indications. The trajectory intercepts $\alpha_P(0) = 1.0$ and $\alpha_\rho(0) = 0.55$ are obtained; for the ρ-meson width $\Gamma_\rho = 143$ MeV; and for the S-wave scattering lengths $a_0 = (0.15 \pm 0.05)m_\pi^{-1}$, $a_2 = (-0.04 \pm 0.015)m_\pi^{-1}$. (auth)

8632 SOME COMMENTS ON A MULTIPERIPHERAL BOOTSTRAP MODEL. Predazzi, E. (Indiana Univ., Bloomington). Phys. Rev.; 185: 2040-1(25 Sep 1969).

The sum of a series arising in a multiperipheral bootstrap model is explicitly evaluated. (auth)

8633 CONSTRUCTION OF VENEZIANO-LIKE FORMULAS FROM SUPERCONVERGENCE. West, Geoffrey B. (Harvard Univ., Cambridge, Mass.). Contract No. AT(30-1)-2076. Phys. Rev.; 185: 1927-8(25 Sep 1969).

The constraints of general superconvergence relations on the $\pi\pi$ scattering amplitude are discussed. (auth)

8634 PHASE CONTOURS AND BOOTSTRAPS. II. Chiu, Charles B.; Eden, Richard J.; Green, Michael B. (Cavendish Lab., Cambridge, Eng.). Phys. Rev.; 185: 1734-47(25 Sep 1969).

The phase-contour method is applied to reactions of the types PP → PP, PP → PV, and PP → PT, where P, V, and T denote, respectively, the pseudoscalar mesons π, η, K; the vector mesons ρ, ω, K^*; and the tensor mesons A_2, f^0, K^{**}. Relations are obtained between zeros of the collision amplitudes and the resonance poles associated with the appropriate Regge trajectories. In a narrow-resonance approximation, and with a unitarity hypothesis that relates certain residue zeros and symmetry zeros of a collision amplitude, bootstrap constraints, which are generalizations of the Veneziano constraint, are obtained on the trajectory functions. A number of other ways of deriving these constraints are discussed. These constraints are then studied for all allowed meson reactions of the types noted above, and are compared with data on the Regge parameters that have been obtained from experiment. (auth)

8635 VECTOR MESONS 1960–1968. Sakurai, J. J. (Univ. of Chicago). Lect. Theor. Phys.; 11-A: 1-21(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

Some of the advances in vector meson physics in the past eight or nine years are reviewed. These include the idea of conserved currents and universality, vector meson dominance of electromagnetic processes of hadrons, and the construction of a gauge-invariant Lagrangian model yielding the current-field identity for the ρ meson. Three classes of experimental tests are discussed: (1) the study of purely hadronic processes to test ρ meson universality, $f_{\rho\pi\pi} \rightarrow f_{\rho NN}$; (2) attempts to see whether f_ρ measurable in $\rho \rightarrow e^+e^-$ agrees with $f_{\rho\pi\pi}$ determined from ρ decay; and (3) using ρ-photon analogy to examine whether analogous electromagnetic

and hadronic processes are characterized by the universal ratio e/f_ρ. Some remaining problems are also mentioned. (L.B.S.)

8636 BJORKEN LIMIT, POLE DOMINANCE, AND $\omega\rho\pi$ SYSTEM. Brown, Stanley G. (Cornell Univ., Ithaca, N. Y.). Lect. Theor. Phys.; 11-A: 159-73(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

A particular version of pole dominance is discussed with specific reference to the $\omega\pi\rho$ system. The method leads to three unknown constants to describe three observable decays. The possibility of using the Bjorken limit and assumptions about commutators between spatial components of currents to obtain further restrictions is discussed. Results of various models and experimental data for the three parameters are discussed. (L.B.S.)

8637 A MODEL FOR $\pi\pi$ AND $K\pi$ S-WAVE PHASE SHIFTS FROM CURRENT ALGEBRA AND PCAC. Renner, B. (California Inst. of Tech., Pasadena). Lect. Theor. Phys.; 11-A: 187-97(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

Some elements of the algebra of current divergences are used to construct a model for $(\pi\pi)$ and $(K\pi)$ s-wave phase shifts in the channels of isospin 0 and $\frac{1}{2}$, respectively. Extensive application is made of pion-pole dominance. (L.B.S.)

8638 NUCLEON RESONANCES AND OFF-MASS-SHELL SELF-CONSISTENCY CONDITIONS. Sugawara, Masao (Purdue Univ., Lafayette, Ind.). Lect. Theor. Phys.; 11-A: 411-40(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

It is shown that a simple way of understanding and also correlating various baryon resonances may be provided by a study of the off-mass-shell decay amplitudes in which the baryon resonances decay into a pion and other baryon resonances. The off-mass-shell self-consistency conditions are first derived. The analysis of the nucleon resonances which are seen in a recent phase-shift analysis is given in terms of these self-consistency conditions. (L.B.S.)

8639 THE FACTORIZATION MODEL AND π-π PHASE SHIFTS IN THE ρ^0 REGION. Gutay, L. J. (Purdue Univ., Lafayette, Ind.); Carmony, D. D.; Loeffler, F. I.; Meiere, F. T.; Csonka, P. L. Lect. Theor. Phys.; 11-A: 631-52(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

The factorization model used to deduce the δ_0^0 phase shifts in the ρ region from the reaction $\pi^- + p \rightarrow \pi^+ + \pi^- + n$ is discussed. The model is a generalization of the absorption model. (L.B.S.)

8640 DECAY MATRIX ELEMENTS FOR $f\pi$ DECAYING SYSTEMS AND DALITZ-PLOT DENSITY ALONG THE f^0 BANDS. Cantore, A.; Mandelli, L. (Univ., Milan. Istituto Nazionale di Fisica Nucleare, Milan). Lect. Theor. Phys.; 11-A: 669-77(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

The formalism of angular-momentum tensors is used to determine the decay matrix elements for the case $X = f\pi$. The density of the Dalitz plot for a 3π system coming from a state $X(J^P)$ decaying into three pions, via an intermediate state $f^0(J^P = 2^+)$ plus a pion, is calculated using the formulas developed by C. Zemach. Results are presented for a 3π mass band of 1.58 to 1.84 GeV^2 and a 2π mass band of 1.15 to 1.35 GeV^2. (L.B.S.)

8641 REGGE POLE EXCHANGE MODELS FOR HIGH ENERGY πN, NN, AND $\bar{N}$N ELASTIC SCATTERING. Barger, V. (Stanford Univ., Calif.). Lect. Theor. Phys.; 11-A: 575-99(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

Possible interpretations of the structures in the differential cross sections for elastic πN, NN, and $\bar{N}$N interactions in terms of exceptional points on Regge trajectories are discussed. (L.B.S.)

8642 TEST OF DUALITY BASED ON KHURI AMPLITUDES. Aoki, Masakazu; Hori, Setsuko; Saito, Takesi (Osaka Univ.). Progr. Theor. Phys. (Kyoto); 42: 871-8(Oct 1969).

Sum rules based on "Khuri" amplitudes are applied to πN backward scattering, in order to check that the equivalence between s-channel resonances and u-channel Regge poles holds at least on the average. (auth)

8643 DIFFRACTIVE REGGE POLE MODEL AND CONSPIRACY RELATION. Biyajima, Minoru (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 42: 987-9(Oct 1969).

The forward peak of $\gamma p \rightarrow \pi^+ n$ and $pn \rightarrow np$ scattering was previously explained by the Regge pole model with the diffractive correction. It is shown that conspiracy requirements of the invariant amplitudes at $t = 0$ are satisfied by the unitarity correction term due to pion pole and diffractive scattering. The π^+ photoproduction, NN and $N\bar{N}$ scattering, and $\pi N \rightarrow \rho N$ scattering are considered. (L.B.S.)

8644 ANALYSIS OF HIGH-ENERGY pp, $\bar{p}p$, $\pi^\pm p$ ELASTIC SCATTERING IN TERMS OF MULTIPLE SCATTERING MECHANISM IN THE COMPOSITE MODEL. Wakaizumi, Seiichi (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 42: 903-25(Oct 1969).

The breaks or dip-bump sequences in the differential cross sections for pp, $\bar{p}p$ and $\pi^\pm p$ elastic scattering are explained by the multiple scattering mechanism of composite particles in the quark model. The total cross section, Re/Im ratio of forward scattering amplitude, polarization, angular dependence of the phase of scattering amplitude and their energy dependences of these processes are calculated as well as the energy dependence of the differential cross sections. The relation between the phase and the energy dependence of total scattering amplitude suggested by analyticity theory (e.g. the generalized Pomeranchuk theorem) is tested for our multiple scattering model of composite particles. Moreover, since two cases about the spatial dimension of quark in the hadron have been proposed by Kokkedee and van Hove as the physical ground of the validity of "additivity assumption," it is shown that one of the two cases is valid in which the quarks have spatial dimensions which are small compared to the corresponding hadrons. (auth)

8645 VENEZIANO-TYPE FORMULA FOR PION ELECTROMAGNETIC FORM FACTOR. Oyanagi, Yoshio (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 42: 898-902(Oct 1969).

An expression for the electromagnetic form factor of the pion is derived by using the Veneziano amplitudes for $\pi\pi \rightarrow \pi\pi$ and $\pi\pi \rightarrow \pi A_1$ together with the field-current identity and current algebra. This model predicts $\sqrt{\langle r_\pi^2 \rangle} = 0.83$ fm. It is also shown that A_1 decays into ρ and π mainly in the S wave. (auth)

8646 SHORT-RANGE INTERACTIONS AND ANALYTICITY IN MOMENTUM TRANSFER. Finley III, J. D. (Univ. of California, Berkeley). J. Math. Phys. (N. Y.); 10: 2047-59 (Nov 1969).

Possible characterizations of "short-range" interactions are investigated by means of conditions on the total transition probability $||T\psi||^2$. It is required that the total transition probability decreases exponentially as the displacement of the wave packet ψ increases. It is shown that this can only be done for certain types of sequences of wave packets, and a criterion is developed for selecting these "proper" wave packets. It is then shown for all such interactions that what is essentially the square of the scattering amplitude is analytic, in the cosine of the scattering angle, in an ellipse which always includes the physical region. These results are then compared with the Schroedinger potential theory and thereby the type of the exponential decrease of a potential is related to the type of the exponential decrease of the corresponding transition probability. Finally, the results are compared with similar results previously obtained. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 8639, 8641, 8643, and 8644.

8647 (ITEF-699) ELASTIC πN SCATTERING AND CHARGE EXCHANGE ACCOUNTING FOR THE CONTRIBUTIONS OF THE BRANCHINGS. Glebov, V. Yu.; Kaidalov, A. B.; Sukhorukov, S. T.; Ter-Martirosyan, K. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1969. 38p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The analyses of the experimental data on $\pi^\pm p$ scattering and $\pi^- p$-charge exchange are carried out in the framework of the compiex angular momentum method. The branch points in j-plane are taken into account. Their contribution to the amplitudes of the processes are parametrized in a simple form which corresponds to the "optical" model of the successive rescatterings. Good agreement with the experiment is achieved in the region of the small momentum transfer. (auth)

8648 (JINR-P2-4798) ON THE UPPER AND LOWER LIMITS OF THE ELEMENTARY PARTICLE RADIUS. Dao Vong Dyc; Nguyen Van Hieu (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 8p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Expressions for the upper and lower limits of elementary particle radius containing the values of the form factor modulus on the cut were obtained. With this aim a corresponding extremal problem of the analytic function theory was solved. If the form factor modulus of π-meson is expressed by the resonance formula

of the Breit–Wigner type which corresponds to ρ-meson then it follows from the results obtained that π-meson radius is equal to $\sqrt{\langle r^2 \rangle} = 0.62 \pm 0.12$ ferm. (auth)

8649 SPIN-2 EXCHANGE IN THE PROCESS $\pi^- + p \rightarrow \eta + n$ AND THE η-NUCLEON COUPLING CONSTANT. Deans, S. R.; Wooten, J. W. (Univ. of South Florida, Tampa). Phys. Rev.; 185: 1797-1801(25 Sep 1969).

A model which consists of direct-channel resonances and a nonresonant background of nucleon and A_2 pole terms is used to fit the data below 2-GeV c.m. energy for the process $\pi^- + p \rightarrow \eta + n$. A good fit is achieved with $\chi^2 = 82$ for 83 data. The branching fractions are calculated for the decay of the isospin-$\frac{1}{2}$ nucleon resonances into the ηN channel, and a realistic upper limit of 0.5 is placed upon the η-nucleon coupling constant. (auth)

8650 ONE-MESON-EXCHANGE CALCULATION OF THE $\pi + p \rightarrow \rho + p$ REACTION. Giltinan, D. A.; Tobocman, W. (Case Western Reserve Univ., Cleveland). Phys. Rev.; 185: 1849-51 (25 Sep 1969).

The distorted-wave theory of the one-meson-exchange reaction is applied to the $\pi + p \rightarrow \rho + p$ reaction at 2.0 GeV/c. This theory introduces the absorptive effects by means of a complex optical potential for the elastic scattering in the incident and exit channels. The distorted-wave method predicts a modification of the ρ-decay correlation by the elastic absorption and scattering effects in addition to that which would arise from a spin dependence of the optical potentials. This contribution is not present in other strong-absorption peripheral-model treatments. The calculation yields satisfactory fits either to the differential cross section or to the ρ-meson decay angular correlation on the basis of spin-independent spherical optical potentials. However, a set of spin-independent optical potentials which would give a fit to both the differential cross section and the ρ-meson decay correlation could not be found. (auth)

8651 PRODUCTION AND DECAY OF $(\mu^+\mu^-)$ ATOMS. Bilen'kii, S. M.; Nguyen Van Hieu; Nemenov, L. L.; Tkebuchava, F. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 10: 812-14(Oct 1969). (In Russian).

Production of $(\mu^+\mu^-)$ atoms in reactions involving hadrons and γ quanta is considered. The decay of such systems is also considered. Atoms produced by π and K mesons, are discussed. (auth)

8652 BARYON EXCHANGES FROM u-CHANNEL FINITE-ENERGY SUM RULES. Barger, V. (Univ. of Wisconsin, Madison); Michael, C.; Phillips, R. J. N. Contract No. AT(11-1)-884. Phys. Rev.; 185: 1852-8(25 Sep 1969).

Finite-energy sum rules (FESR) are used to study the u-channel baryon Regge exchanges in πN and KN elastic scattering. The low-energy integrals over the $\bar{N}N \rightarrow \pi\pi$ and $\bar{N}N \rightarrow \bar{K}K$ cuts are evaluated by resonance saturation, including $\sigma(0^+)$, $\rho(1^-)$, $\omega(1^-)$, $A_2(2^+)$, $f^0(2^+)$, $\rho(3^-)$, and $\omega(3^-)$ meson poles. The integral over the $\pi N \rightarrow \pi N$ cut is evaluated in both the phase-shift and the resonance-dominance approximation, whereas resonance saturation only is used for the $\bar{K}N \rightarrow \bar{K}N$ and $KN \rightarrow KN$ discontinuities. The FESR integrals thus obtained are in reasonable agreement with existing Regge-exchange fits to high-energy scattering data. In particular, the following interesting results are obtained from the FESR: (i) The N_α and Λ_α exchange amplitudes change sign at u values appropriate to $\alpha = -\frac{1}{2}$, as required by conventional Regge theory. (ii) The spin dependence of the N_α and Λ_α exchange amplitudes is predicted in the scattering region. (iii) The Λ exchange contributions dominate over Σ exchange contributions in KN backward elastic scattering. (auth)

8653 PION–NUCLEON BREMSSTRAHLUNG. Picciotto, Charles (Univ. of Victoria, B. C.). Phys. Rev.; 185: 1761-4 (25 Sep 1969).

A model-independent calculation of πN bremsstrahlung differential cross sections is presented. The πN amplitude is obtained from the available data on elastic πN scattering. Specific results are calculated for positive pions on protons at pion laboratory energies between 150 and 300 MeV and various values of pion and nucleon angles. (auth)

8654 USE OF SPIN-DENSITY MATRIX ELEMENTS TO TEST FEYNMAN-DIAGRAM MODELS OF REGGEIZATION. Morrow, Richard A. (Dartmouth Coll., Hanover, N. H.). Phys. Rev.; 185: 1764-7(25 Sep 1969).

In the Van Hove–Durand model of Reggeization, as extended by Blankenbecler and Sugar to include particles with spin, it is shown that the spin-density matrix elements of ρ mesons produced by scattering pions off nucleons have the property that $(\rho_{11} - \rho_{1,-1})/\rho_{00}$, in the high-energy limit, is dependent only on abnormal-parity Reggeons, of which the pion is the dominant contributor. Combining this result with the relation $\rho_{00}(\rho_{11} - \rho_{1,-1}) \simeq 2(\mathrm{Re}\rho_{10})^2$, which is shown to hold in the same limit, it is concluded that the quantity $(\mathrm{Re}\rho_{10})/\rho_{00}$ should depend mainly on pion exchange. Using this latter ratio, it is shown that neither minimal nor maximal derivative coupling alone in the model is consistent with data at 8-GeV/c pion momentum. (auth)

8655 PREDICTION OF $Y^* \Xi K$ COUPLINGS BY SUPER-CONVERGENCE. Seth, V. P.; Agarwal, B. K. (Univ. of Allahabad, India). Phys. Rev.; 185: 1723-5(25 Sep 1969).

Superconvergent sum rules were constructed for the process $\bar{K}N \rightarrow K\Xi$ and were used to predict the coupling constants for the vertices $Y_0^*(1405)\Xi K$, $Y_0^*(1520)\Xi K$, and $Y_0^*(1660)\Xi K$ by saturating the sum rules with the low-lying intermediate states. (auth)

8656 TOTAL DECAY RATE OF UNSTABLE PARTICLES. Ram, Michael (State Univ. of New York, Buffalo). Lect. Theor. Phys.; 11-A: 441-53(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

A recent investigation on the lifetime of unstable particles using a quantum field theory approach is described. A definition is first given of the total decay rate of particles that decay via the weak interaction, and a simple expression is derived in terms of the S-matrix. It is then shown that this definition coincides with that of the total decay rate defined in terms of the imaginary part of the propagator pole to second order in the coupling constant. It is conjectured that the expression for the total decay rate of an unstable particle is also applicable to hadron resonances, and relations among hadron resonance widths are derived analogous to the Gell-Mann–Okubo mass relations. (L.B.S.)

8657 DIFFRACTION DISSOCIATION. Walker, W. D. (Univ. of Wisconsin, Madison). Contract AT(11-1)-881. Lect. Theor. Phys.; 11-A: 679-94(1969). (COO-881-157).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

The characteristics of diffraction dissociation are examined for two processes $\pi^- + p \rightarrow \pi^- + \pi^+ + N$ and $\pi^- + p \rightarrow \pi^- + \pi^0 + p$. (L.B.S.)

8658 A SIMPLE OPE MODEL FOR THE REACTION $K^- p \rightarrow K^- p \pi^+ \pi^-$ NEAR 5.0 GeV/c. Kopelman, J. B. (Univ. of Colorado, Boulder); Libby, L. Marshall; Urvater, E. M.; Juhala, R. E.; Leacock, R. A.; Rhode, J. I.; Campbell, W. B. Lect. Theor. Phys.; 11-A: 717-43(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

The final state $K^-p \rightarrow K^-p\pi^+\pi^-$ interaction near 5.0 GeV/c is considered as proceeding principally through two simple noninterfering OPE diagrams in which diffraction scattering of the exchanged pion occurs at each vertex of each diagram. The model predictions for cross sections, Δ^2 distributions, and mass spectra are compared with experimental data. Partial cross sections are estimated for all intermediate channels through which the $K^-p\pi^+\pi^-$ final state proceeds, and the results are presented. (L.B.S.)

8659 PRESENCE OF HARD CORE IN HIGH ENERGY PION PROTON SCATTERING. Rost, E.; Libby, L. Marshall (Univ. of Colorado, Boulder). Contract AT(11-1)-1537. Lect. Theor. Phys.; 11-A: 745-55(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

A single imaginary absorptive Yukawa potential with a radial cutoff or hard core is found to fit the πp elastic scattering data at GeV energies. (L.B.S.)

8660 REGGE POLE PHENOMENOLOGY WITH ABSORPTIVE CORRECTIONS. Blackmon, Maurice L. (Argonne National Lab., Ill.). Lect. Theor. Phys.; 11-A: 601-16(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

An attempt is made to fit data for π^+p elastic scattering and π^-p charge exchange scattering with an absorptively corrected Regge phenomenology. Comparisons of calculated cross sections and polarizations with data are shown. (L.B.S.)

8661 SOME COMPARISON BETWEEN TWO BODY AND THREE BODY REACTIONS IN THE FRAMEWORK OF REGGE POLES. Ratti, Sergio P. (INFN, Milan). Lect. Theor. Phys.; 11-A: 617-29(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

Comparison is made between diffractive parameters for two-body and three-body πp interactions in the Regge pole model. Decay

angular distributions of the ρ^0, f^0 and Δ^{++} are also discussed. (L.B.S.)

8662 O(3,1) SYMMETRY AND THE REACTION $\pi + N \rightarrow \rho + N$ AT HIGH ENERGY. Nath, L. M.; George, D. J. (Purdue Univ., Lafayette). Progr. Theor. Phys. (Kyoto); 42: 926-40 (Oct 1969).

The high energy behavior of the differential cross section was examined along the forward direction for the reaction $\pi + N \rightarrow \rho + N$ from the idea of O(3,1) symmetry. The scattering amplitude was expanded in terms of irreducible unitary representations of O(3,1) and their asymptotic behavior determined. In this way, the fact was rederived that at high energy, transversely polarized mesons are produced dominantly by M = 1 Toller poles, and longitudinally polarized ones by M = 0 Toller poles (M is a casimir operator of O(3,1)). The Toller poles were decomposed into families of Regge poles and the residues of the Regge poles with different signature and parity have been correlated. These dynamical relations between the residues of the conspiring Regge trajectories were shown to be consistent with the kinematical constraints on the helicity amplitudes. (auth)

8663 SINGLE π-PRODUCTION IN π-NUCLEON COLLISIONS. Young, J. E.; Rich, M. (Los Alamos Scientific Lab., N. Mex.). pp 201-16 of In Honor of Philip M. Morse. Feshbach, Herman; Ingard, K. Uno (eds.) Cambridge, Mass.; Massachusetts Institute of Technology Press (1969).

The interactions $\pi + n \rightarrow 2\pi + N$ below 1 GeV is studied in the framework of the previously proposed static model approximation. The compositeness assumption is discussed. (J.F.P.)

8664 FINITE ENERGY SUM RULES FOR MULTIPLE PRODUCTIONS. Yamagishi, Kenji (Waseda Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 42: 887-97(Oct 1969).

Assuming the analyticity and the multi-Regge behaviors of the scattering amplitude at high energies, finite energy sum rules for multiple productions are discussed. The sum rules give a new kind of consistency condition between a quasi-two-body Regge amplitude and a double Regge amplitude in the case of reactions with three particles in the final state, and imply a relation between the daughter trajectories and the Toller variable dependence of the inner vertices of double Regge graphs. General cases are also discussed. (auth)

8665 THE π-N DIFFERENTIAL CROSS SECTION IN CROSSED FORM. Sakmar, Ismail A. (Univ. of Western Ontario, London). Progr. Theor. Phys. (Kyoto); 42: 879-86(Oct 1969).

Two differential cross-section formulas for positive and negative u regions of the s channel are derived in terms of the u-channel f_1, f_2 amplitudes which are suitable for the application of Regge formalism. In particular the limits of these expressions are formed for u = 0 and the direct channel formulas are recovered. (auth)

8666 DIFFRACTIONAL DISINTEGRATION OF HADRONS AT SUPERHIGH ENERGIES AND THE POSSIBILITY OF LARGE QUARK PRODUCTION RATES. Dooher, J. (Grumman Aerospace Corp., Bethpage, N. Y.). Phys. Rev. Lett.; 23: 1471-3 (22 Dec 1969).

The breakup of hadrons into their constituent quarks is considered in a simple model. It is demonstrated that the cross section for quark production with this mechanism could be in the millibarn range. Experimental evidence for such a process in cosmic-ray interactions is discussed. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 8564, 8641, and 8644.

8667 PROTON–PROTON SCATTERING AT HIGH ENERGY AND THE STRUCTURE OF THE PROTON. Cromer, A. H. (Atomic Energy Research Establishment, Harwell, Eng.). Phys. Rev.; 185: 1731-3(25 Sep 1969).

Diffraction-model parameters obtained for small-momentum-transfer data are used to calculate the proton-proton cross section at larger momentum transfers. Predictions of both the quark and droplet models of the proton are compared with the data. (auth)

8668 CHANGE OF MECHANISM OF PARTICLE INELASTIC INTERACTIONS WITH NUCLEI IN THE ENERGY REGION T ~ 5 GeV. Barashenkov, V. S.; Gudima, K. K.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 10: 755-9(Oct 1969). (In Russian).

Analysis of the known experimental data on inelastic nucleon and pion nuclear interactions shows that the energy dependence of different parameters related to the production of slow cascade and evaporation particles, changes in the energy region T ~ 5 GeV. This change is of the "saturation" type, and thus to explain it the conventional model of internuclear cascades must be considerably modified. One of the possible explanations is based on the advancing decrease of the number of nucleons in nucleus as the internuclear cascade develops. (auth)

8669 INELASTIC INTERACTIONS OF HIGH-ENERGY DEUTERONS WITH ATOMIC NUCLEI. Barashenkov, V. S.; Gudima, K. K.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 10: 760-5(Oct 1969). (In Russian).

A cascade-evaporation model of the deuteron-nucleus interactions with account of the stripping processes is considered by means of the Monte-Carlo method. In calculations the diffuseness of the nucleus boundary was taken into account and the exact conservation of the energy and momentum was satisfied. The meson production processes were included into the theory with the result that the energy region above 1 GeV may be considered. A reasonable quantitative agreement with the whole amount of the available experimental data is noted. (auth)

8670 FAILURE OF SOFT-PION TECHNIQUES FOR THE REACTION $pp \rightarrow d\pi^+$ AT THRESHOLD. Schillaci, M. E.; Silbar, R. R. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev.; 185: 1830-4(25 Sep 1969).

The reaction $pp \rightarrow d\pi^+$ at threshold is studied using the low-energy theorem of Adler and Dothan. Predictions are found to be in serious disagreement with experimental results, both in the soft-pion limit and for physical pion mass. The inapplicability of the low-energy theorem for this process is traced to the rapid decrease of the deuteron vertex as a function of pion mass. Internal emission diagrams of the one-pion-exchange type, which vary much less rapidly with pion mass, are likely to dominate in the limit of physical pion mass. A similar analysis applies to the processes $K^-d \rightarrow \Lambda n, \Sigma^0 n$ for kaons at rest, where the soft-kaon result disagrees with experiment even more seriously than above. (auth)

8671 HIGH-ENERGY pp SCATTERING AND PROTON SUBSTRUCTURE. IV. Islam, M. M. (Univ. of Connecticut, Storrs); Rosen, Joe. Phys. Rev.; 185: 1917-26(25 Sep 1969). (NYO-2262TA-202).

Results of a systematic analysis of high-energy pp elastic-scattering data in terms of a proton-substructure model are presented. The model satisfactorily describes differential cross sections over the entire momentum range 5 to 31 GeV/c and over the whole angular interval 0 to 90°. pp elastic differential cross sections at future accelerator energies (70, 200, and 1600 GeV) are also predicted. The model indicates that the proton has two hadronic core distributions, which interact via exchange of vector mesons ω (~800 MeV) and ω' (~2200 MeV). The rms radii of these distributions are 0.44 and 0.20 F. (auth)

8672 REGGE CUTS AND ITERATIVE PROCEDURES IN DIFFRACTION SCATTERING. O'Donovan, Patrick J. (Univ. of Chicago). Phys. Rev.; 185: 1902-9(25 Sep 1969).

Freund and O'Donovan's dynamical model for Regge cuts is extended to proton-proton diffraction scattering. The input Pomeranchukon is given a phenomenological representation corresponding to a flat trajectory. The question of which part of the total amplitude to identify with the input Pomeranchukon is examined in the context of a generating-function formalism. Consistency with the above-mentioned model and other physical requirements corresponds to restrictions on this generating function. Some new and some previously proposed iterative models for diffraction scattering are considered: (1) a rescattering model (Van Hove), (2) a mixed rescattering-absorption model, (3) an eikonal (Chou-Yang, Frautschi-Margolis) model, and (4) a K-matrix model. Models (2)–(4) are consistent with our requirements and exhibit reasonable (and very similar) asymptotic differential cross sections. Possible modifications for nonasymptotic energies are discussed. (auth)

8673 S-WAVE BARYON–BARYON SCATTERING IN THE QUARK MODEL. Sastry, C. V.; Subrahmanyam, C. (Regional Engineering Coll., Orissa, India). Phys. Rev.; 185: 2027-9(25 Sep 1969).

S-wave baryon-baryon scattering is considered in the quark model with a T_3^1 breaking term in the quark space. Thirteen sum rules for various baryon-baryon amplitudes for scattering in the $^1S_0$ state and 10 sum rules for scattering in the $^3S_1$ state are obtained. (auth)

8674 TWO-TEMPERATURE STATISTICAL MODEL OF PARTICLE SPECTRA. II. LaPointe, M.; Wayland, J. R. (Univ. of Maryland, College Park). Phys. Rev.; 185: 2041-2 (25 Sep 1969).

The two-temperature statistical model for the spectra of particles produced in proton-proton collisions was modified to place an upper limit on the momentum of the secondaries. New expressions for the transverse momentum distribution, multiplicity, and the cross section $d^3N/dp_t^2dp_z^*$ are given. Fitting parameters are given for the new formulation. (auth)

8675 BARYON-BARYON INTERACTIONS IN THE FINAL STATE FOR MESON + d → MESON + (Y,N). Davis, Howard F. (Univ. of Washington, Seattle). Lect. Theor. Phys.; 11-A: 757-72(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

The study of baryon-baryon interactions in the final state from various reactions of the type meson + d → meson + (Y,N) is discussed. It is noted that it is at least kinematically possible to produce and observe directly essentially all types of possible bound (Y,N) states. (L.B.S.)

8676 RELATIVISTIC $^3P_0$ BOUND STATE IN THE PS(ps) COUPLING. Murota, Toshiyuki (Hokkaido Univ., Sapporo); Noda, Matu-Tarow. Progr. Theor. Phys. (Kyoto); 42: 989-91 (Oct 1969).

The nucleon-nucleon scattering phase shift was previously calculated by use of the Nambu–Salpeter–Bethe (N–S–B) equation where approximations of the π-ladder were used and the negative energy contribution was neglected. The result was that the $^3P_0$ phase shift at zero momentum is 2π, which means that the $^3P_0$ state has two bound states. The eigenvalue problem of the N–S–B bound-state equation is considered under the same approximation. (L.B.S.)

8677 OVERLAPPING POTENTIALS AND MULTIPLE SCATTERING THEORY. Feshbach, Herman (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)2098. pp 190-200 of In Honor of Philip M. Morse. /Feshbach, Herman; Ingard, K. Uno (eds.). Cambridge, Mass.; Massachusetts Institute of Technology Press (1969).

A formulation of multiple scattering theory is proposed which makes use of the impact parameter approximation and the expansion of the phase shift function in one-, two-, and many-body operators. Explicit results are given for the case in which the expansion is truncated after two terms, retaining the one- and two-body terms. Evaluation is obtained by appropriate use of the semiclassical physical optical approximation. It is used to show that the effect of the overlap in the incident-nucleon–target-nucleon potentials can be important for the determination of correlations in the target nuclear wave function by elastic scattering. The use of experiments which are more sensitive to correlation effects is thus recommended. (auth)

8678 REQUIREMENT OF DUALITY AND p–p ($\bar{p}$–p) ELASTIC SCATTERING. Minami, Shigeo; Karasuno, Toshiaki (Osaka City Univ.). Progr. Theor. Phys. (Kyoto); 42: 983-5(Oct 1969).

It is shown that the duality concept is inconsistent with experimental data for pp and $\bar{p}p$ elastic scattering at about $t = -0.5$ $(GeV/c)^2$. (L.B.S.)

8679 VARIATIONAL PRINCIPLE FOR n–d SCATTERING. Hasegawa, Kenji (Fukui Univ., Japan). Progr. Theor. Phys. (Kyoto); 42: 799-814(Oct 1969).

The Kohn variational principle for two-body scattering is extended to n-d scattering at arbitrary (nonrelativistic) energies of the incident neutron. Two-body local potentials of central type are assumed. Expressions are obtained for the amplitude of the elastically scattered wave which are accurate to first order in the error of the wave functions. It turns out that these expressions reduce to those which are given by the conventional no-polarization approximation when the trial functions are taken to be the wave functions obtained by this approximation. (auth)

8680 p–p SCATTERING MATRIX IN THE GeV-ENERGY REGION. I. p–p PHASE SHIFTS AT 0.97 GeV. Hoshizaki, Norio; Kadota, Tsuyoshi (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 42: 815-25(Oct 1969).

A phase shift analysis of the p-p scattering data at 0.97 GeV is reported. Two previously found solutions of the peripheral and central absorption types are refined by following the proposed scheme of analysis and by using the recent new experimental data. Two solutions corresponding to the old ones are obtained again, both of which confirm the previous conclusion that the low-energy interaction picture is still consistent with the experimental results even at this energy. Importance of measurements on the depolarization parameter at large scattering angles is pointed out to discriminate between the two solution types. (auth)

8681 p–p SCATTERING MATRIX IN THE GeV-ENERGY REGION. II. p–p PHASE SHIFTS AT 1.4 GeV. Hoshizaki, Norio; Kadota, Tsuyoshi (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 42: 827-36(Oct 1969).

Results of a phase shift analysis of the p-p scattering data at 1.4 GeV are reported. The proposed scheme of analysis is slightly modified by adding effects of the double-pion production on the outer absorptions. By following this modified scheme, two solutions of the peripheral absorption type are obtained. Both solutions are consistent with the picture on two-nucleon interactions as derived from the lower energy data. The two solutions are somewhat different from each other in their singlet real and triplet P real phases. The difference is mostly reduced if the rotation parameter R is measured at large scattering angles. (auth)

8682 THREE-PION-EXCHANGE CONTRIBUTION TO NUCLEON–NUCLEON SCATTERING THROUGH SIMPLE 3π–$N\bar{N}$ DIAGRAMS. Furuichi, Susumu (Rikkyo Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 42: 837-60(Oct 1969).

General formulas are given for the three-pion-exchange contribution in nucleon–nucleon scattering for the purpose of their fully non-static evaluation. The 3π–$N\bar{N}$ amplitude is discussed in relation to their contribution to nucleon–nucleon scattering. Contributions from the 3π–$N\bar{N}$ diagram with the one-pion pole to nucleon–nucleon scattering are examined in somewhat detail as the simplest example. When a constant approximation to the pion-pion scattering amplitude is made, the contribution behaves like that of exchange of an iso-vector pseudoscalar boson with the effective mass of 800 ~ 900 MeV. The pion-pion correlation effects are also investigated for the 3π–$N\bar{N}$ diagrams with the one-pion pole. It is found that mean values of the three-pion effective mass are shifted toward the heavier mass side by the two-pion correlations. In particular the P-wave correlation effect is almost immaterial for the region (three-pion effective mass)^2 $<\sim 30\mu^2$, μ being the pion mass. (auth)

Particle Invariance Principles and Symmetries

Refer also to abstract 8571.

General

Refer also to abstracts 8572, 8705, and 8717.

8683 (IC–69-140) GROUP THEORY. PART I. LECTURE NOTES 1–7. Lectures given at the International Centre for Theoretical Physics (Advanced School of Physics), Trieste, February–March 1969. Niederle, J. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1969. 109p. Dep. CFSTI (U. S. Sales Only).

The basic concepts and theorems of representation theory of finite groups and Lie groups are presented. In order to keep the treatment as simple as possible, most of the proofs are omitted and only a core of ideas for understanding current applications of group methods is considered. Moreover, the meaning of theorems and definitions is explained in detail and is illustrated by examples. (auth)

8684 CROSSING AS A GROUP AND ELIMINATION OF EXOTIC CHANNELS. Yahil, Amos (California Inst. of Tech., Pasadena). Phys. Rev.; 185: 1786–8(25 Sep 1969).

Crossing transformations constitute a group of permutations under which the scattering amplitude is invariant. Using Mandelstam's analyticity, the amplitude is decomposed into irreducible representations of this group. The usual quantum numbers, such as isospin or SU(3), are "crossing-invariant." Thus no higher symmetry is generated by crossing itself. However, elimination of certain quantum numbers in intermediate states is not crossing-invariant, and higher symmetries have to be introduced to make it possible. The current literature on exchange degeneracy is a manifestation of this statement. To exemplify application of our analysis, it is shown how, starting with SU(3) invariance, crossing and the absence of exotic channels can be used to derive the quark-model picture of the tensor nonet. No detailed dynamical input is used. (auth)

8685 SYMMETRIES OF THE RELATIVISTIC HYDROGEN ATOM. Mandula, Jeffrey E. (California Inst. of Tech., Pasadena). Contract No. AT(11-1)-68. Phys. Rev.; 185: 1774–85 (25 Sep 1969).

The structure of the symmetry group of the relativistic hydrogen atom (no spins) is determined, in order to study how a symmetry

group which places particles of different spin in the same supermultiplet can be incorporated into a relativistic theory. The difficulties associated with the extension of the symmetry group of the bound states to bound-state scattering are discussed. (auth)

8686 ALGEBRA OF CURRENT DIVERGENCES. Renner, B. (California Inst. of Tech., Pasadena). Lect. Theor. Phys.; 11-A: 257-62(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

The commutators of changes and current divergences are studied, and some information is obtained on the equality of $\pi_{\mu 2}$ and $K_{\mu 2}$ decay constants, the square meson mass formula, and SU(3) violations. Information is also obtained on the question of how the large SU(3) violations in the pseudoscalar system are compatible with previous successful SU(3) deductions on the rate of K_{l3} decay and the baryon-meson Yukawa coupling constants. (L.B.S.)

8687 SYMMETRY BREAKING. Michel, Louis (Institut des Hautes Etudes Scientifiques, Bures-Sur-Yvette, France). Lect. Theor. Phys.; 11-A: 263-71(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

Some ideas, mathematical tools, and a new theorem related to the breaking of physical symmetries are presented. The following theorem is conjectured and applied to the breaking of SU(3) symmetry: Consider a real valued differentiable function f defined on the compact manifold M and invariant by the differentiable action of the compact Lie group G on M. Then f has at least one extremum (grad f = 0) on each connected piece of each minimal stratum. (L.B.S.)

8688 MATRICES OF FINITE LORENTZ TRANSFORMATIONS IN A NONCOMPACT BASIS. I. DISCRETE SERIES OF O(2,1). Mukunda, N. (Tata Inst. of Fundamental Research, Bombay). J. Math. Phys. (N. Y.); 10: 2086-92(Nov 1969).

The problem of obtaining the matrices that represent finite group elements in unitary irreducible representations of the group O(2,1) is considered in a basis in which the "noncompact" generator of an O(1,1) subgroup is diagonal. The discrete series of representations is treated and expressions obtained for the matrix elements of group elements belonging both to the O(2) subgroup and the other O(1,1) subgroup. (auth)

8689 INTERNAL-LABELING PROBLEM. Sharp, R. T.; Lam, C. S. (McGill Univ., Montreal). J. Math. Phys. (N. Y.); 10: 2033-8(Nov 1969).

A method is proposed for labeling the bases of a compact group when reduced with respect to an arbitrary subgroup. The scheme is based on the observation that the heaviest state of a multiplet (subgroup irreducible representation) of an IR (group irreducible representation) can be labeled by a product of heaviest states of simpler "elementary" multiplets. Details are worked out for a number of group–subgroup combinations. (auth)

Applications (Electromagnetic and Weak)

8690 ELECTROMAGNETIC SIMULATION OF TIME-REVERSAL VIOLATION IN MIRROR SPIN-$\frac{3}{2}$ BETA DECAYS. Chen, Herbert H. (Princeton Univ., N. J.). Contract No. AT(11-1) Gen 10. Phys. Rev.; 185: 2003-6(25 Sep 1969).

With time-reversal invariance, the β-decay correlation $\langle J\rangle/J \cdot p_l \times p_\nu$, where $\langle J\rangle/J$ is the polarization of the decaying nucleus and p_l (p_ν) is the momentum of the electron (neutrino), can arise only through a final-state electromagnetic interaction. For allowed transitions with vector and axial-vector couplings, this effect is recoil-dependent. It was shown by Callan and Treiman that this effect, for the special class of spin-$\frac{1}{2}$ mirror transitions, and the assumption of the conserved-vector-current (CVC) hypothesis, is dominated by weak magnetism. A corresponding calculation for the class of spin-$\frac{3}{2}$ mirror transitions, of which the decay $^{35}Ar \rightarrow {}^{35}Cl + e^+ + \nu_e$ is an example, shows a similar domination by weak magnetism. The magnitude of this effect is estimated for several mirror β transitions. (auth)

8691 ELECTROMAGNETIC SIMULATION OF T VIOLATION IN THE A = 12 TRIAD BETA DECAY. Chen, Herbert H. (Univ. of California, Irvine). Contract No. AT(11-1)-Gen-10. Phys. Rev.; 185: 2007-8(25 Sep 1969).

Electromagnetic final-state effects are considered in the absence of T violation for the A = 12 β processes $^{12}B \rightarrow {}^{12}Ce^-\bar{\nu}$ and $^{12}N \rightarrow {}^{12}Ce^+\nu$. The emphasis is to determine the contribution which gives rise, in the decay spectrum, to the polarization of the parent nucleus normal to the decay plane. It is shown that this polarization is directly dependent on weak magnetism. The conserved-vector-current theory is used to estimate the magnitude of this effect. It is found to be significantly larger then the corresponding values in mirror β decays. (auth)

8692 CP-VIOLATION IN WEAK INTERACTIONS. Maiani, L. (Istituto Superiori di Sanita, Rome). Lect. Theor. Phys.; 11-A: 919-29(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

The classification of the weak currents according to their G-parity is first discussed. Cabbibo's theory for weak interactions of hadrons and the question of lepton–hadron universality are discussed. Experimental implications of the semileptonic weak Hamiltonian are considered. Two models are considered: current × current + octet enhancement. (L.B.S.)

8693 NEUTRAL KAONS AND CP. Faissner, H. (Technische Hochschule, Aachen). Lect. Theor. Phys.; 11-A: 773-842(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

Section I gives a review of the classical work of Gell-Mann and Pais on neutral kaons in strong and weak interactions. The behavior of free neutral kaons is dealt with in section II. The decay matrix and the mass matrix are written in terms of the Pauli matrices. Section III deals with neutral kaons interacting with matter and coherent regeneration. The total Hamiltonian is given in terms of the Pauli matrices, thereby providing at the same time a model for CP-violation by cosmological effects. Coherent regeneration in a plate of finite thickness is treated in detail. The phenomenology of CP-violation in neutral kaon decays is presented in section IV. Possible sources of CP-violation concludes the discussion. (L.B.S.)

8694 EXPERIMENTS ON CP-VIOLATION IN K^0-DECAYS. Faissner, H. (Technische Hochschule, Aachen). Lect. Theor. Phys.; 11-A: 843-99(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

Experimental studies of CP-violation K^0 decays are discussed within the framework of the phenomenological theory developed by Wu and Yang. The following topics are considered: $K_L^0 \rightarrow \pi^+\pi^-$; phase of the amplitude $K_L^0 \rightarrow \pi^+\pi^-$; leptonic neutral kaon decays; and $K_L^0 \rightarrow \pi^0\pi^0$. The present state of the Wu–Yang triangle is discussed in the concluding section. (L.B.S.)

8695 SEARCH FOR C-VIOLATION IN ETA DECAYS. (A REVIEW). Bazin, Maurice (Rutgers–The State Univ., New Brunswick, N. J.). Lect. Theor. Phys.; 11-A: 901-9(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

A systematic review is given of the present status of the experimental investigation of C-nonconserving effects in the decays of the eta meson. It is shown that no conclusion can be reached from present experimental knowledge about the existence of an abnormal part in the electromagnetic current. It is also shown that it is extremely difficult to obtain more insight into the possibility of C-violation at the level of accuracy required in eta decays with presently available techniques. (L.B.S.)

8696 STATUS OF EXPERIMENTAL SEARCHES FOR CP VIOLATION IN OTHER THAN NEUTRAL K-DECAYS. Wattenburg, A. (Univ. of Illinois, Urbana). Lect. Theor. Phys.; 11-A: 911-18(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

The experimental searches for CP violation in other than neutral K decays are summarized. Three sets of experiments are shown to be at a level of a fraction of 1%: $K^\pm \rightarrow \pi^\pm\pi^+\pi^-$, the search for the electric dipole of the neutron; and the experiments on eta decays. Experiments planned or in progress are also summarized. (L.B.S.)

8697 SATURATION OF CURRENT ALGEBRAS IN DYNAMICAL GROUP MODELS. Corrigan, D.; Hamprecht, B. (Univ. of Colorado, Boulder). Lect. Theor. Phys.; 11-A: 299-343(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

The idea of group dynamical models of particle vertices is viewed as a straightforward generalization of Dirac's method of obtaining the electromagnetic form factors of the electron (up to radiative corrections). A representation of O(4,2) is constructed for describing baryon states, and it is shown how this particular representation may be used to calculate vertex functions for electromagnetic interactions. It is then assumed that the rest frame states of baryons and baryon resonances can be labeled by the quantum numbers of the group O(4,2) × SU(3). It is shown how the

dynamical group currents can be made to saturate a subset of the algebra of currents at infinite momentum with the single particle states of the group representation. A model which uses the O(4,2) framework and which incorporates the restrictions of current algebra is presented. (L.B.S.)

8698 SOFT PION EVALUATION OF MASS DIFFERENCE, GAUGE INVARIANCE, AND SPECTRAL FUNCTION SUM RULES. Deshpande, N. G. (Northwestern Univ., Evanston, Ill.). Lect. Theor. Phys.; 11-A: 175-85(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

It is first shown that the soft pion extrapolation of a matrix element involving electromagnetic phenomena leads to a loss of gauge invariance. A brief review is then given of the work of Barger and Kazes on gauge invariant formulation for the electromagnetic mass difference, and the results are used to study the soft-pion calculation. The asymptotic SU(3) method of obtaining sum rules is reviewed and some applications of the new sum rule are given. (L.B.S.)

8699 HARD MESON CURRENT ALGEBRA TECHNIQUES AND APPLICATIONS. Arnowitt, R.; Nath, Pran (Northeastern Univ., Boston). Lect. Theor. Phys.; 11-A: 87-158(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

Hard pion and hard kaon techniques based on the SU(2) × SU(2) and SU(3) × SU(3) chiral current algebras are described. In addition to the chiral current commutation relations, the method assumes CVC, PCAC, dominance of intermediate states by low-lying single meson states, and a definite amount of momentum dependence in particle vertices. The technique is applied to the decays $\rho \to 2\pi$, $A_1 \to \rho + \pi$, $K^* \to K + \pi$, the pion electromagnetic form factor, peripheral processes involving meson vertices, π-π scattering and the K_{l3} form factors. The interrelation between the chiral current algebra and the chiral invariance approaches is discussed. The reason for the absence of a current algebra derivation of the KSFR relation is examined. Hard pion deviations to the soft pion Callan–Treiman relation are obtained and found to be large if a $I = \frac{1}{2}$, $J = 0$ κ meson exists. (auth)

Applications (Strong)

Refer also to abstract 8699.

8700 ASYMPTOTIC SYMMETRY, LAGRANGIAN GAUGE MODEL, AND THE PVV VERTEX. Chan, L. H. (Yale Univ., New Haven); Clavelli, L.; Torgerson, R. Contracts No. AT (30-1)-2726; AT(11-1)-1545. Phys. Rev.; 185: 1754-60(25 Sep 1969).

A model is studied in which SU(3) breaking in the PVV vertex is determined by the requirement of asymptotic nonet symmetry. A vector-meson gauge model is constructed which satisfies this asymptotic symmetry condition. The model also incorporates the usual asymptotic symmetry result for the VPP vertex, the field-current identities, and the algebra of fields. Nevertheless, a second Weinberg sum rule of the Das-Mathur-Okubo form is obtained, and consequently, a quadratic mass formula is obtained as in a mass-mixing model. The predictions of the model are compared with available experimental data on meson decays involving the PVV vertex. The predicted rates for radiative decays of vector mesons are also given. (auth)

8701 FORMULATIONS OF CHIRAL DYNAMICS. Kawarabayashi, Ken (Kyoto Univ.). Lect. Theor. Phys.; 11-A: 227-41 (1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

A method of constructing nonlinear chiral invariant Lagrangians is summarized. Some observations are made with regard to the physical consequences derived from such chiral gauge invariant Lagrangians for the KSRF relation and Weinberg's mass relation, chiral transformation rules of ρ and A_1, and $A_1 \to \rho + \pi$ and $A_1 \to 3\pi$ couplings. An alternative form of chiral invariant Lagrangian is presented in which ρ and A_1 obey non-linear chiral transformation rules, and its physical implications are examined. (L.B.S.)

8702 LIE ALGEBRA OF A RELATIVISTIC ROTATOR. Corben, H. C. (TRW Systems, Redondo Beach, Calif.). Lect. Theor. Phys.; 11-A: 359-75(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

The present status of knowledge of relativistic wave equations which purport to describe rotational states of hadrons is summarized. The Lie algebra that is associated with the relativistic theory of a particle which is assumed to carry with it a set of axes which are described in a relativistic covariant way is examined. (L.B.S.)

8703 IRREDUCIBILITY OF THE LADDER REPRESENTATIONS OF U(2,2) WHEN RESTRICTED TO THE POINCARE SUBGROUP. Mack, G. (Univ. of Miami, Coral Gables, Fla.); Todorov, I. J. Math. Phys. (N. Y.); 10: 2078-85(Nov 1969).

It is shown that the most degenerate discrete series of unitary irreducible representations of U(2,2), the so-called ladder representations, remain irreducible when restricted to representations of the Poincaré subgroup ISL(2,C). They correspond to representations of this subgroup with mass zero and arbitrary integer or half-integer helicity λ. The basis vectors of the canonical basis are calculated as functions of a lightlike 4-vector, which is formed by the simultaneous eigenvalues of the generators of the subgroup of translations. (auth)

Field Theories

Refer also to abstract 8571.

General

8704 DYNAMICAL SYMMETRIES IN CLASSICAL AND QUANTUM MECHANICS. Vitale, B. (Univ. of Naples). Lect. Theor. Phys.; 11-A: 405-09(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

A study is made of the general structure of the realizations of the allowed (finite dimensional) Lie algebras corresponding locally to transformation groups over an n-dimensional dynamical space D(n). The allowed Lie algebra L is one whose generators can be expressed as functions of the dynamical variables q_i, p_i ($i = 1, \ldots n$). q_i, p_i, and T are elements of a Hoesenberg algebra H_n, realized in terms of either Poisson brackets (classical mechanics) or quantum commutators (quantum mechanics). The generators will correspondingly close under either a Poisson bracket or a commutator algebra isomorphic to L. (L.B.S.)

Quantum Field Theory

8705 (DESY-69/36) RENORMALIZABLE MODELS WITH SIMPLE SYMMETRY BREAKING. I. SYMMETRY BREAKING BY A SOURCE TERM. Symanzik, K. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Sep 1969. 47p. Dep. CFSTI (U. S. Sales Only).

If to a Lagrangian density with invariance under a continuous group of linear transformations of the fields a term linear or bilinear in the fields is added, the symmetry is in general reduced and the currents associated with the original symmetry are only partially conserved. If the theory without the added term is renormalizable, the theory with that term also is, and the needed renormalization conditions are the essential content of the appropriate Ward-Takahashi-Kazes-Rivers identities. The case of symmetry breaking by a term linear in Bose fields (source term) is analyzed completely, in particular with respect to the nonsymmetric limit of vanishing source term, a particular Goldstone mode, and with respect to properties of the ground state energy density as a function of the strength of the source term. Induced and spontaneous breaking of a discrete symmetry are also treated. (auth)

8706 PARTICLES WITH IDENTICAL QUANTUM NUMBERS AND CONDITIONS Z = 0 IN SCALAR FIELD THEORY. Braun, M. A.; Izergin, A. G. (Leningrad State Univ.). Yadern. Fiz.; 10: 873-80(Oct. 1969). (In Russian).

The conditions $Z = 0$ are discussed for the case of N particles with identical quantum numbers in the scalar field theory. It is shown that the conditions $Z^{(i)} = 0$ ($i = 1, 2, \ldots, N$) transform all these particles into composite particles and determine their masses. The conditions $Z_{ii} = 0$ ($i = 1, 2, \ldots, N$) determine the charges of composite particles. Nondiagonal elements of the matrix Z_{ik} vanish automatically. (auth)

8707 HEISENBERG FIELD IN THE THIRRING MODEL. Astakhov, A. V. (Moscow Mining Inst.). Yadern. Fiz.; 10: 883-8(Oct 1969). (In Russian).

The effect of the choice of the canonical commutation relations on properties of the solutions of the quantum-field theory dynamical equations is considered with the four-fermion Thirring interaction as an example. It is shown that using the representations in nonphysical space of states one gets a violation of the locality condition for the Heisenberg field. The possibility is found that some matrix elements of different fields constructed using non-

equivalent representations of the canonical commutation relations, may coincide. (auth)

8708 INFINITE-COMPONENT FIELD THEORIES, FUBINI SUM RULES, COMPLETENESS, AND CURRENT ALGEBRA. II. MIXED SPECTRA. Fronsdal, C. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev.; 185: 1768-73 (25 Sep 1969).

Results reported previously for infinite-component field theories with discrete mass spectra are extended here to the case of mixed spectra—partially discrete and partially continuous. A class of Majorana theories, including the Schrödinger theory of the hydrogen atom as well as relativistic models, is shown to satisfy normal completeness relations. As shown previously, this is equivalent to the existence of local current commutation relations and the possibility of constructing local fields. Spacelike solutions contribute, but only those with real energy. A model without spacelike solutions is shown to be nonlocal, and an attempt is made to estimate the extent of nonlocality. It is possible to adjust the parameters so that the deviation from a strictly local current algebra becomes insignificant. (auth)

8709 T PRODUCTS AT HIGH ENERGY AND COMMUTATORS. Jackiw, R.; Preparata, G. (Harvard Univ., Cambridge, Mass.). Contract No. Nonr-1866(55). Phys. Rev.; 185: 1929-40(25 Sep 1969).

It is shown that in perturbation theory the high-energy behavior of T products is not, in general, governed by canonical equal-time commutators. Criteria for the applicability of canonical commutators in this limit are developed. Interaction-dependent modifications to commutators are calculated. (auth)

8710 CANONICAL REPRESENTATION OF A FIELD THEORY OF CURRENTS. Weisz, P. H. (Univ. of Cambridge, Eng.). Phys. Rev.; 185: 2015-19(25 Sep 1969).

Canonically equivalent families of spin-zero meson nonlinear Lagrangian field theories in which the underlying symmetry is SU(n) × SU(n) are rewritten in terms of currents. A completely symmetric theory is shown to provide a canonical representation of an SU(n) theory of currents of the same structure as Sugawara's. The model does not provide a representation of Sugawara's K(n) theory of currents; however, a comparison is made between the two models. (auth)

8711 UNITARY CLOSED LOOPS IN REGGEIZED FEYNMAN THEORY. Bardakci, K.; Halpern, M. B.; Shapiro, J. A. (Univ. of California, Berkeley). Phys. Rev.; 185: 1910-17(25 Sep 1969).

The factorized tree graphs of the generalized Veneziano model are used to construct, through the tree theorem, all graphs with one closed loop. While unitary in the sense of perturbation theory, the loops contain a new "particle counting" divergence related to the very large number of daughters in the trees. (auth)

8712 INVARIANCES OF APPROXIMATELY RELATIVISTIC LAGRANGIANS AND THE CENTER-OF-MASS THEOREM. I. Havas, Peter (Temple Univ., Philadelphia); Stachel, John. Phys. Rev.; 185: 1636-47(25 Sep 1969).

In Newtonian mechanics the ten classical integrals of the equations of motion of a system of interacting point particles can be related to the invariance of the corresponding Lagrangian under the ten infinitesimal transformations of the Galilei group. Systems described by approximately relativistic equations [such as the Darwin equations in special relativity and the Einstein-Infeld-Hoffmann (EIH) equations in general relativity] also possess ten integrals of equivalent physical significance; previous work has established similar relations with invariance properties of the Lagrangian for only seven of these, but not for the three expressing the uniform motion of the center of mass. It is shown here that for any Lagrangian whatever which is a function of the particle positions and velocities alone, and which is invariant under the infinitesimal time and space translations, it is possible to find an additional exact invariance under a three-parameter set of infinitesimal transformations (which, in general, depends on a functional rather than a function). The transformations define a velocity which for approximately relativistic systems can be interpreted as that of their center of mass; for such systems the three conservation laws following from this transformation express the constancy of this velocity. A number of examples are given; for the Darwin and EIH equations, the conservation laws agree with those previously obtained directly from these equations. (auth)

8713 SUGAWARA MODEL, STRESS TENSOR, AND SPECTRAL SUM RULES. Mahanthappa, K. T.; Palmer, D. R. (Univ. of Colorado, Boulder). Contract No. AF-AFOSR-30-67. Phys. Rev.; 185: 1970-4(25 Sep 1969).

A prescription is presented for modifying the stress tensor of the Sugawara model in order that it become consistent with general postulates of field theory. The prescription involves redefining the stress tensor as the limit of a spatially nonlocal operator. Within the context of the modified theory, sum rules are derived by considering the vacuum expectation value of equal-time stress-tensor commutators. Variations of the limiting procedure are also considered. It is shown that convergent Weinberg second sum rule in the framework of the Sugawara model leads to a null theory. The existence of a nontrivial Sugawara model leads to a specific behavior of the cross section for positron-electron annihilation into hadrons at high energies. (auth)

8714 QUARK FIELD ALGEBRA, GAUGE FIELD ALGEBRA, AND SCHWINGER TERMS. Kim, C. W.; Repko, W. W.; Sato, A. (Johns Hopkins Univ., Baltimore). Phys. Rev.; 185: 1983-9 (25 Sep 1969).

By analyzing commutators of the Fourier-transformed space-time current components, certain properties of the Schwinger terms in current algebra are investigated. It is shown that the connected part of the expectation value of the Schwinger term vanishes in the infinite-momentum limit. Also, sum rules based on the space-space commutators of quark field algebra and gauge field algebra are derived and discussed with special attention to contributions of the pair and class-II states. In principle, these sum rules can be used to determine which of these two versions of current algebra is valid. (auth)

8715 THEORIES AT INFINITE MOMENTUM. Halpern, M. B. (Univ. of California, Berkeley). Lect. Theor. Phys.; 11-A: 345-58(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

Some recent work toward the construction of theories at infinite momentum is described. A Schroedinger representation of the Poincaré group is introduced for one and two free particles at infinite momentum. The Hamiltonian in these representations has the usual nonrelativistic structure. A construction is given for introducing an interaction (potential) between these particles. The construction of second-quantized representations is briefly mentioned. (L.B.S.)

8716 CONNECTIONS BETWEEN WARD IDENTITIES, PHENOMENOLOGICAL LAGRANGIANS, AND ALGEBRA OF FIELDS. A VIEW FROM THE BRIDGE. Schnitzer, Howard J. (Brandeis Univ., Waltham, Mass.). Lect. Theor. Phys.; 11-A: 65-85(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

It is shown how the results of phenomenological Lagrangians are obtained within the framework of current algebra by means of a well-defined set of approximations, and how the matrix elements of the algebra of fields emerge from Ward identities in a natural way if the hadron proper amplitudes are not too singular at high energies. The Ward identity techniques applied to the vacuum expectation values of currents, obeying equal-time commutation rules and PCAC, are first described, and the connections with the effective Lagrangians and algebra of fields are then presented. The discussion is limited to the three- and four-point functions of currents for illustrative purposes, although the methods apply equally well to an arbitrary n-point function of currents. (L.B.S.)

8717 REPRESENTATIONS OF INTERNAL SYMMETRY GROUPS FOR SELF-CONJUGATE FIELDS. Carruthers, P. (Cornell Univ., Ithaca, N. Y.). Lect. Theor. Phys.; 11-A: 933-49(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

Recent work has shown that local field theory gives restrictions on the allowed representations of internal symmetry groups for self-conjugate fields. A review is given of various aspects of this problem, emphasizing two complementary features: locality-causality considerations and TCP invariance. For a general internal symmetry group the representations D must be transformable to a real basis to satisfy the usual requirements of local field theory. For isospin, this criterion eliminates isospinors (2I = odd); for SU(3) only symmetric representations (with p = q) are allowed. These results are true for any spin. A few remarks are made on the properties of interacting SCIF (self-conjugate isofermion) fields. Such theories are quite pathological, lacking causality, crossing symmetry and usually TCP invariance. A model for CP violation, in which the W meson is a SCIF, is studied. A non-covariant energy dependence of the CP violating decay amplitude is predicted. (auth)

8718 DERIVATION OF THE MOST GENERAL RELATIVISTIC TRANSFORMATION LAW OF QUANTUM FIELDS. Ingraham,

R. L. (New Mexico State Univ., Las Cruces). Lect. Theor. Phys.; 11-A: 951-6(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

The most general relativistic transformation law of quantum fields is derived from the relativity principle. In the special case of frame-dependent fields it reduces to the familar forms of the current quantum field theory, due originally to Wigner. The formalism allows the incorporation of a cut-off into quantum fields and thus into the S-matrix. (L.B.S.)

8719 HIGH ENERGY EXPERIMENTS ON QED. Bernardini, Carlo (Comitato Nazionale per l'Energia Nucleare, Frascati, Italy). Lect. Theor. Phys.; 11-A: 465-91(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

A review is given of recent experimental tests of quantum electrodynamics in the high-energy region. The kinematics of the two-body electromagnetic interactions are briefly summarized. The following conclusions are made. Electron data at the space-like virtual momenta appear to be good at up to ~700 MeV for virtual photons, 500 MeV for virtual electrons; muon data up to ~800 MeV (virtual muons) are somewhat worse. For the time-like momenta, data are poorer or limited to lower values (400 to 800 MeV for photons from $eC \rightarrow eC\mu^+\mu^-$, 100 MeV for electrons from wide-angle bremsstrahlung experiments. (L.B.S.)

8720 FLUX QUANTIZATION, CHARGE QUANTIZATION, AND THE ELECTROMAGNETIC COUPLING CONSTANT. Jehle, Herbert (George Washington Univ., Washington, D. C.). Lect. Theor. Phys.; 11-A: 493-521(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

An attempt is made to describe the electromagnetic field of a charged lepton (electron or muon) in terms of quantized flux. A quantized flux line, attributed to a source lepton, is assumed to have the form of a closed loop, a form resembling the magnetic field lines of a lepton with a magnetic moment. In order to interpret that magnetic field, it is assumed that this flux loop may adopt alternative forms, and that to each alternative flux loopform a complex probability amplitude is attached, in a manner analogous to the attachment of probability amplitudes to alternative path histories in Feynman's space-time approach to quantum mechanics. It is seen that, if the choice of such amplitudes is made so as to reconstruct the magnetic field of a Bohr magneton $e\hbar/2mc$ and if the set of alternative loopforms is assumed to perform a spinning motion with angular frequency $mc^2/\hbar$, the Coulomb field results without the ad hoc introduction of electric charge (the same Coulomb field for electron or for muon alike). A space-time distribution of alternative loopforms is employed to attempt an explanation of the electromagnetic field in terms of the quantized flux Φ_0, of the energy mc^2 and angular momentum $\hbar/2$ solely in terms of electromagnetic field energy and angular momentum. (L.B.S.)

8721 GROUP-THEORETIC APPROACH TO WAVE FUNCTIONS AND FIELDS. Nilsson, Jan (Inst. of Theoretical Physics, Goteborg). Lect. Theor. Phys.; 11-A: 377-403(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

A procedure is outlined in which use is made of a carrier space which is larger than the one chosen by Wigner, corresponding to more general wave functions for constructing field-theoretic models with interactions. Alternative realizations of the unitary irreducible representations of the restricted Poincaré group are obtained in which also the spin operators may be represented by differential operators. Quantized fields are then constructed, which in general turn out to violate microscopic causality. A simple field-theoretic model is briefly discussed as a first attempt to understand some features of strong interaction physics. (L.B.S.)

8722 ON A TRIPLET INCLUDING THE HILBERT SPACE OF ENTIRE FUNCTIONALS. Rzewuski, J. (Univ. of Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.; 17: 459-66(1969).

Previously conditions for a functional power series to belong to the Hilbert space H were considered. Two spaces T and T* are defined such that $T^* \supset H \supset T$. Functional power series and their functional derivatives are classified with respect to the triplet $T^* \supset H \supset T$. (J.F.P.)

8723 HILBERT SPACE OF ENTIRE FUNCTIONALS. Rzewuski, J. (Univ. of Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.; 17: 453-8(1969).

In quantum field theory of one real scalar field the convergence and asymptotic behavior of functional power series and double series and their functional derivatives with respect to complex-valued functions on a three-dimensional Euclidean space, irrespective of their dependence on time, is investigated. It is noted that the investigation can be considered as a preliminary step in formulating a mathematically well-defined description of quantum field theory in terms of generating functionals. (J.F.P.)

8724 STATISTICAL THEORY OF FIELDS. Yilmaz, Hueseyin. pp 179-80 of In Honor of Philip M. Morse. /Feshbach, Herman; Ingard, K. Uno (eds.). Cambridge, Mass.; Massachusetts Institute of Technology Press (1969).

An approach to quantum field theory is formulated which deviates from the conventional approach only through the imposition of certain statistical constraints on the field operators, but the formal apparatus of the theory as it depends on these operators is unaltered. Thus the forms of the equations of motions, Lagrangian, Feynman diagrams, etc. are the same. Differences occur in the evaluation of the Feynman graphs since the new theory has modified commutators and propagators. All serious divergences are shown to disappear. (J.F.P.)

8725 FEYNMAN-PARAMETRIC FORMULA FOR THE HANKEL-TRANSFORMED POSITION-SPACE FEYNMAN INTEGRAL. Nakanishi, Noboru (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 42: 966-77(Oct 1969).

The Feynman-parametric formula for the Hankel-transformed position-space Feynman integral is derived, in which various representations of the denominator function are presented. Some remarks are made on the duality between the momentum-space function and the position-space one and its breakdown. (auth)

8726 VERTEX FUNCTIONS AT LARGE MOMENTUM TRANSFER. III. MODELS FOR THE WU-YANG-TYPE FORM FACTOR. Minami, Masatsugu (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 42: 941-58(Oct 1969).

A series of models are constructed for the momentum-space vertex functions with a view of demonstrating a correspondence between the exponential decrease of the Wu-Yang type and the infinite oscillation of the spectral function such as $\bar{\Delta}(\kappa,\rho)$. The last one of our examples is most interesting in the sense that it invokes $\bar{\Delta}_3(\kappa_1,\kappa_2,\kappa_3;\ \rho_1,\rho_2,\rho_3)$, which is a generalization of $\bar{\Delta}(\kappa,\rho)$. The triple $(\kappa_1,\kappa_2,\kappa_3)$ or (ρ_1,ρ_2,ρ_3) will also be introduced in the preceding examples, but by an iterative application of $\bar{\Delta}(\kappa_i,\rho_i)$. It is finally argued that the triple (ρ_1,ρ_2,ρ_3) may have a connection with a non-locality of the double commutators. (auth)

8727 ON CANONICAL SO(4,1) TRANSFORMATIONS OF THE DIRAC EQUATION. Bracken, A. J.; Cohen, H. A. (Univ. of Adelaide). J. Math. Phys. (N. Y.); 10: 2024-32(Nov 1969).

Certain matrix transformations of the free-particle Dirac equation are described as momentum-dependent SO(4,1) transformations. Such of these belonging to any one of five subgroups $G^{(\alpha)}$ ($\alpha = 0, 1, 2, 3, 4$) are canonical, preserving the Lorentz-invariant Dirac scalar product in a corresponding one of five modes of expression. The Dirac equation itself is linear in all five components $p_\alpha[p_\mu(\mu = 0, 1, 2, 3)$ is the four-momentum operator, and $p_4 = m]$ of the "five-vector" $\tilde{p}$, and a transformation in $G^{(\beta)}$ has the additional property that the component p_β appears linearly also in the transformed equation. The Mendlowitz and the Foldy–Wouthuysen–Tani transformation accordingly are in $G^{(0)}$, the SO(4) subgroup; and that proposed by Chakrabarti is in $G^{(4)}$, the SO(3,1) subgroup associated with homogeneous Lorentz transformations. For any $\tilde{p}'$, obtained from $\tilde{p}$ by a momentum-dependent SO(4,1) transformation, there is a corresponding transform of the Dirac equation. Where p_α appears in the Dirac equation, p'_α appears in the transformed equation. The ambiguities which arise in the specification of the transformation leading to a given such equation are associated with the existence of a "little group" for any such $\tilde{p}'$. (auth)

8728 SPECTRAL REPRESENTATION OF THE COVARIANT TWO- POINT FUNCTION AND INFINITE-COMPONENT FIELDS WITH ARBITRARY MASS SPECTRUM. Todorov, I. T. (International Center for Theoretical Physics, Trieste, Italy); Zaikov, R. P. J. Math. Phys. (N. Y.); 10: 2014-19(Nov 1969).

The general form of a Lorentz covariant two-point function is written down in momentum space as an expansion in terms of the total spin eigenfunctions. It leads naturally to a local expression for finite-component fields, but incorporates nonlocal infinite-component fields. Explicit examples of such fields with increasing mass spectrum are constructed. The two-point function is shown to fall exponentially for large spacelike separations provided that the lowest mass in the theory is positive. (auth)

8729 V-PARTICLE DECAY IN THE LEE MODEL. Hammer, C. L.; Weber, T. A. (Ames Lab., Iowa). J. Math. Phys. (N. Y.); 10: 2067-77(Nov 1969).

The formalism developed previously for scattering of wave

packets is applied to the N + θ sector of the Lee model. A single analysis suffices to discuss both the stable and unstable case. The rate at which N and θ particles are produced and the number of V particles produced are calculated as a function of time assuming that the incident wave is initially a semi-infinite, plane-wave train. An unstable V-particle state is constructed from the $|N,\theta\rangle$ state by requiring agreement with the scattering analysis. Its dependence on the production process is explicitly shown. The state can be made independent of the production process by requiring normalization. The time dependence of each channel is also calculated for this case. It is shown that both the unstable and stable V-particle states can be generated from the mathematical V-particle state, the only difference being the location of the pole which describes the resonance state or the bound state. (auth)

8730 LORENTZ TRANSFORMATION DERIVED FROM FIRST-ORDER EXPERIMENTS. **Pfleiderer, J. (Univ. of Colorado, Boulder). Amer. J. Phys.; 37: 1131-4(Nov 1969).**

The electric field that is created in a moving magnetic field can be used to establish the Lorentz transformation without considering the constancy of light velocity or the full set of Maxwell's equations. (auth)

Gravitation and General Relativity

8731 SHEAR-FREE GRAVITATIONAL RADIATION. **Derry, Louis; Isaacson, Richard; Winicour, Jeffrey (Aerospace Research Labs., Wright-Patterson Air Force Base, Ohio). Phys. Rev.; 185: 1647-55(25 Sep 1969).**

It is shown that, with the exception of the Schwarzschild metric, gravitational systems described by suitably regular vacuum solutions of Einstein's equations admitting a shear- and twist-free congruence of diverging null rays must be radiative. Robinson and Trautman have demonstrated the existence of type-II solutions of this kind, which describe radiating gravitational systems with bounded sources. However, attempts to display an explicit radiative solution through specialization to conformally spherically symmetric, Kerr-Schild, conformally Kerr-Schild, and type-D space times lead to singular metrics. Finally, important physical properties of these systems, including energy, angular momentum, radiation flux, and trapped surfaces, are discussed. (auth)

8732 OPERATIONAL FORMULATION OF THE PRINCIPLE OF EQUIVALENCE. **Anderson, J. L. (Stevens Inst. of Tech., Hoboken, N. J.); Gautreau, R. Phys. Rev.; 185: 1656-61(25 Sep 1969).**

A formulation of the principle of equivalence is given that avoids some of the difficulties in the more usual statements of the principle. In particular, an operational definition of local systems is given for which the principle is applicable. The relation between the statement and other statements of the principle is discussed. To investigate the relation of the statement to general relativity, model reference frames are constructed from physical systems whose dynamics are sufficiently simple that their behavior can be described within the framework of the general theory without the need to introduce extraneous assumptions. With the help of these reference frames, it is then shown that it is possible to formulate gedankenexperiments yielding results that satisfy our statement of the principle. (auth)

8733 CONSTANT ACCELERATION IN CURVED SPACE–TIME. **Gautreau, Ronald (Newark Coll. of Engineering, N. J.). Phys. Rev.; 185: 1662-3(25 Sep 1969).**

Based on an analysis of various gedankenexperiments, criteria are given that determine when a particle moves with constant acceleration in curved space. It is shown that for a certain restricted case, the criteria are equivalent to those for constant acceleration proposed previously by Rindler and by Marder. (auth)

8734 SPHERICALLY SYMMETRIC STATIC SOLUTIONS OF EINSTEIN'S EQUATIONS. **Leibovitz, Clement (Tel-Aviv Univ., Israel). Phys. Rev.; 185: 1664-70(25 Sep 1969).**

A formal general solution of Einstein's equations in the static case containing an arbitrary function of r is obtained. A necessary and sufficient condition that the arbitrary function must satisfy in order that the solution be physically meaningful in the neighborhood of the center is established. A mapping from Newtonian solutions is indicated. The case of infinite pressure at the center is considered. New solutions are given as examples. (auth)

8735 MORE ABOUT TACHYONS. **Bilaniuk, Olexa-Myron (Swarthmore Coll., Pa.); Brown, Stephen, L.; DeWitt, Bryce; Newcomb, William A.; Sachs, Mendel; Yoshikawa, Shoichi; Sudarshan, E. C. George. Phys. Today; 22: No. 12, 47-52(Dec 1969).**

A discussion of tachyon properties is presented. The topics considered are general relativity theoretical implications, tachyonic Cherenkov radiation, causality violation, and superluminal physics. (J.F.P.)

8736 ACOUSTICS AND GENERAL RELATIVITY. **Westervelt, Peter J. (Brown Univ., Providence). pp 153-63 of** In Honor of Philip M. Morse. /Feshbach, Herman; Ingard, K. Uno (eds.). Cambridge, Mass.; Massachusetts Institute of Technology Press (1969). (NYO-2262TA-192).

It is shown that within the context of linearized relativity theory all physical quantities normally calculated using the second rank field tensor can be far more easily obtained by means of an equivalent scalar theory. The scalarization of a normally tensorial theory is brought about by the introduction of isotropic tensor sources which, by their very nature, cannot alter the physical content of the theory. The introduction of isotropic sources leads to a radical computational simplification and to a formal analogy with the linearized theory of acoustics. The technique of scalarizing and the method applied to an extended oscillator and a spinning rod are considered. (J.F.P.)

Scattering Theory

Refer also to abstract 8571.

8737 (SU–1206-208) METHODS OF CONSTRUCTING SCATTERING AMPLITUDES CONTAINING RESONANCES OF FINITE WIDTH, AND SATISFYING DUALITY AND REGGE BEHAVIOUR. **Gardiner, C. W. (Syracuse Univ., N. Y. Dept. of Physics). [1968]. 23p. (NYO–3399-208). Dep. CFSTI.**

The compatibility of a scattering amplitude having the expansion $f(s,t) = \Sigma_{n=0}^{\infty} P_n(t)/n + 1 = \alpha(s)$ with Regge behavior: $f(s,t) \sim (e^{-i\pi} s)^{\alpha(t)}$. $A(t)/\sin\pi\alpha(t)$, and it is found that the polynomials, $P_n(t)$ must have an asymptotic expansion as $n \to \infty$ of $P_n(t) \sim A(t)/\pi |a| \cdot |an|^{\alpha(t)}$, where a is the reciprocal of the asymptotic slope of the trajectory function, $\alpha(s)$. It is shown that if this condition is extended to $P_n(t) \sim n^{\alpha(t)} \Sigma_{r=0}^{\infty} B_r(t) n^{-r}$, and if the inverse trajectory function, defined by $\alpha(\nu(n)) = n$ has the asymptotic expansion $\nu(n) \sim an \Sigma_{n=0}^{\infty} b_r n^{-r}$, then an amplitude of the form $A(s, t) = \Sigma_{n=0}^{\infty} P_n(t)$ $s = \nu(n)$ has t-channel poles at the points where $\alpha(t)$ is a positive integer, whose residues are polynomials in s. A model is investigated which is crossing symmetric as well as dual, which can be written in the form $f(s,t) = \Sigma_{n,m}^{\infty} P_n(s) P_m(t) F(m,n)$, which is a generalization of Veneziano's model. It is found that one can guarantee an approximate duality simultaneously with having resonances of finite width, and an example is constructed which can be summed to be a reasonably simple form, for which the Regge behavior, which has unfortunately a number of fixed poles, is explicitly shown. (auth)

8738 (SU–1206-209) TWO VARIABLE EXPANSION OF THE SCATTERING AMPLITUDE FOR ANY MASS AND SPIN AND CROSSING SYMMETRY FOR PARTIAL WAVES. **Balachandran, A. P.; Case, W.; Modjtehedzadeh, M. (Syracuse Univ., N. Y. Dept. of Physics). Oct 1969. 21p. (NYO–3399-209). Dep. CFSTI.**

An infinite number of sum rules are derived for the process a + b → c + d where a, b, c, d, are particles of arbitrary mass and spin. Each of the sum rules involves a finite number of partial waves. They are implied by the crossing symmetry of the system and are complete. A classification of these relations into an independent set suggests a basis for the two variable expansion of the scattering amplitude. The basis has the further virtue that it explicitly displays the threshold and pseudothreshold zeroes of the partial waves. The formalism is also valid for a decay process. The partial waves in the sum rules then refer to amplitudes where two of the three final particles are in a state of definite angular momentum while the region of expansion becomes the Dalitz plot. (auth)

8739 O(3,1) EXPANSIONS OF SCATTERING AMPLITUDE AND REGGE POLES. **Liberman, M. A. (Moscow State Univ.). Yadern. Fiz.; 10: 881-2(Oct 1969). (In Russian).**

The connection between the scattering amplitude in the O(2,1)-group representation and the Regge representation for the scattering amplitude is established. The expansion formulas for the scattering amplitude in the O(3,1)-group representations realized on the functions on cone, are obtained. The simplest form of the expansion coefficients inducing Regge poles is found. (auth)

8740 UNCORRELATED JET MODEL AND CENTRAL INTERACTIONS. **Dremin, I. M. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 10: 822-5(Oct 1969). (In Russian).**

The effect of phases of the inelastic process matrix elements on

the width of the diffraction cone of elastic scattering which is due to these processes is investigated using a concrete model. The possibility of describing the experimental fact of the presence of leading particles when using the uncorrelated jet model as an irreducible term in the Bethe–Salpeter equation is also considered. (auth)

8741 THREE-PARTICLE UNITARITY CONDITION AT COMPLEX ANGULAR MOMENTA FOR A SIMPLE FEYNMAN GRAPH. Azimov, Ya. I. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz.; 10: 832-48(Oct 1969). (In Russian).

An explicit form of the unitarity condition at complex angular momenta j is found. The summing over the momentum projection m is replaced by integration. Inelastic partial amplitudes and their contribution to the unitarity condition are naturally decomposed into several terms. This decomposition is determined by contributions from different singularities. With certain relations between the masses it coincides with the decomposition of the double spectral function into contributions from different sections in the cross channel. The integration over the phase-space volume can be limited by a physical region and by an additional region, the necessity of which was found before. It results in a relatively simple structure of the asymptotics of the double spectral function. (auth)

8742 ω INDEPENDENCE OF INTERNAL REGGE COUPLINGS AT ZERO MOMENTUM TRANSFER. Tan, Chung-I, Wang, Jiunn-ming (Princeton Univ., N. J.). Contract No. AF 49(638)-1545. Phys. Rev.; 185: 1899-1901(25 Sep 1969).

Based on the analyticity properties of production amplitudes, it is proved that the Reggeon-Reggeon-particle coupling $K(t_1,t_2,\omega)$ is independent of the ω angle when either t_1 or t_2 vanishes. This phenomenon is connected with the fact that the surfaces $t_1 = 0$ and $t_2 = 0$ are asymptotes of physical boundaries on which $\cos\omega$ is not defined. The finding allows a considerable simplification of phenomenological analyses of multiparticle production data. (auth)

8743 LORENTZ-POLE STRUCTURE AND DUALITY OF SOME CROSSING-SYMMETRIC AMPLITUDES WITH REGGE BEHAVIOR. Bitar, Khalil M. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev.; 185: 2032-8(25 Sep 1969).

The Lorentz-pole structure of some crossing-symmetric amplitudes with Regge behavior is studied and its implication on factorization is discussed. It is shown that a finite sum of these amplitudes may be taken such that the residues are of a single-Lorentz-pole structure. However, it is subsequently shown that this cannot be carried out for all resonances without destroying the duality of the resultant amplitude. A criterion for duality is presented and used throughout. (auth)

8744 KINEMATIC STRUCTURE OF HELICITY AMPLITUDES FOR MASSLESS PARTICLES. Chang, Lay Nam; Leung, Y. C. (Massachusetts Inst. of Tech., Cambridge). Contract No. AT(30-1)-2098. Phys. Rev.; 185: 1945-59(25 Sep 1969).

A study is made of the kinematic structure of helicity amplitudes describing scattering with massless particles of arbitrary helicities, using certain basic analyticity assumptions on the M functions. The behaviors of the amplitudes at the thresholds and pseudothresholds are given explicitly, and, in the case of photons and gravitons, these give the suppression factors inherent in the various low-energy theorems. Parity conservation is not used, and the results are applicable to weak amplitudes. (auth)

8745 DOUBLED RESONANCES AND UNITARITY. Rebbi, Claudio; Slansky, Richard (California Inst. of Tech., Pasadena). Contract No. AT(11-1)-68. Phys. Rev.; 185: 1838-45(25 Sep 1969).

The constraints of unitarity on a multichannel partial-wave amplitude dominated by two nearby or coincident resonances are derived. The factorization conditions are discussed and used in the solution of these equations. The solutions permit variation in the relative heights of the two peaks in the cross section and variation in the depth of the dip. Single peaks appear in some cross sections, while doubled peaks appear in others. The single peak may be centered at the energy of the dip or displaced to either side, and the amplitude may be imaginary or real at the top of the single peak. The doubled-resonance amplitude is Reggeized and the narrow-width limit is investigated. The amplitude becomes a simple pole with an unfactorizable residue in this limit. Numerical examples of the solutions are also presented. (auth)

8746 IMPLICATIONS OF DIRECT- AND CROSSED-CHANNEL REGGE SELF-CONSISTENCY. Spector, Richard M. (Wayne State Univ., Detroit). Phys. Rev.; 185: 1801-5(25 Sep 1969).

By comparing the t-channel Regge-pole amplitude with the s-channel Regge amplitude, self-consistency is applied for near-forward scattering. Under certain plausible assumptions, this enables the high-energy behavior of the Regge-trajectory function to be evaluated as $\alpha(s) \to (s \ln s)^{\frac{1}{2}}$, and that of the residue function as $\beta(s) \to s^{\alpha(0)-\frac{1}{2}}(\ln s)^{-\frac{1}{2}}$. It is also determined that two trajectories will have the same shape if their derivatives at $s = 0$ are the same, since this derivative alone determines the trajectory shape completely. The resonance content of these trajectories at high s is also examined and found to be empty in the usual sense. (auth)

8747 CONSTRUCTION OF THE S MATRIX FROM ITS LEFT-HAND-CUT DISCONTINUITY, WHEN THE LATTER IS ASYMPTOTICALLY UNBOUNDED. Atkinson, D.; Calogero, F. (Imperial Coll. of Science and Tech., London). Contract No. F6 105267C0084. Phys. Rev.; 185: 1702-16(25 Sep 1969).

A new procedure is proposed for constructing the partial-wave S matrix, given its left-hand-cut discontinuity $\lambda(m)$ ($m = -2ik$, where k is the c.m. momentum). The advantage over the N/D method is that this procedure works even when $\lambda(m)$ is unbounded as $m \to \infty$ (provided that it oscillates in a suitable way); in fact, the new technique works even when $\lambda(m)$ is not bounded by any finite power of m, so that not only does the usual N/D decomposition break down, but there exists no partial-wave dispersion relation with a finite number of subtractions. An equivalent potential is introduced that provides considerable insight into the nature of elementary-particle, bound-state, ghost, and Castillejo-Dalitz-Dyson poles. The method is generalized to include inelastic effects. (auth)

8748 DERIVATION OF A VENEZIANO SERIES FROM THE REGGE REPRESENTATION. Khuri, N.N. (Rockefeller Univ., New York). Contract No. AFOSR 69-1629. Phys. Rev.; 185: 1876-87(25 Sep 1969).

The familiar Watson-Sommerfeld formula is considered for an amplitude with an infinite sequence of parallel Regge trajectories and an arbitrary set of physical residues. This input is supplemented by assuming two features of all Veneziano models, namely, the narrow-resonance approximation and the absence of cuts in the Mandelstam variables. With this input it is shown that the scattering amplitude can always be expressed as an infinite series of Veneziano-like terms. The coefficients of this series are uniquely and explicitly expressed in terms of the residues of the original Regge poles with which we started. Each coefficient is expressed in terms of a power of the forward difference operator acting on a well-defined, though complicated, linear combination of the Regge residues. The convergence of this series is studied in detail, and sufficient conditions are stated that guarantee absolute convergence away from the poles. These conditions are stated in terms of bounds on the growth in s and in the sequence index n of certain linear combinations of the Regge residues. This is the only input required in addition to the usual Regge input supplemented by the narrow-resonance approximation and the absence of branch cuts. Duality is not taken as an input; however, only a fully crossing-symmetric case is treated. Starting with the physical Regge formula guarantees that the Veneziano series has no ghosts as long as the β's used to define the coefficients are physical. A direct check of this fact is given. Having an explicit expression for the coefficients of the series, the conditions that will lead to dominance by the primary term is also investigated. These turn out to give a form for the leading residue which is almost identical to the one that is used in practical fits to the high-energy data. In addition, it turns out that one has to choose the scale that determines the onset of Regge behavior, s_0, to be equal to the inverse of the slope of the Regge trajectory. This again is close to the value of s_0 used in practice. (auth)

8749 PARAMETERS OF THE POLE MODEL. Dilley, James (Ohio Univ., Athens). Lect. Theor. Phys.; 11-A: 977-89(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.2).

The problem of determining the positions and residues of the pole model is discussed. The case of Yukawa potential scattering is considered as an example. The success of the method raises the possibility of performing strong-interaction calculations by using simple Born inputs and threshold behavior to determine the residues using a pole model. (L.B.S.)

8750 THE APPLICATION OF FIXED-POINT THEOREMS TO S-MATRIX THEORY: PROBLEMS OF EXISTENCE AND UNIQUENESS. Atkinson, D. (Imperial Coll. of Science and Tech., London). Lect. Theor. Phys.; 11-A: 523-40(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

A discussion is given on some recent work in which it is shown

that solutions of the Mandelstam unitary equations exist, with full crossing symmetry and not approximated. The discussion is limited to amplitudes that satisfy the Mandelstam representation with an arbitrary but finite number of subtractions. The topics discussed include the generalized Mandelstam prescription; Schauder's fixed-point theorem; proof of the existence theorem in the absence of subtractions; and finite number of subtractions. (L.B.S.)

8751 EXTENTION OF AXIOMATIC ANALYTICITY DOMAINS AND PROOF OF SUPERCONVERGENCE RELATIONS. Mahoux, Gilbert; Martin, Andre (State Univ. of New York, Stony Brook). Lect. Theor. Phys.; 11-A: 541-52(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

It is shown that any regularized helicity amplitude, which is known from axiomatic local field theory to satisfy dispersion relations for $-t_0 \leq t \leq 0$, is in fact analytic in the quasi-topological product $|t| < R \times s$ in the cut plane with cuts $s = C + \lambda$, $s = -t - \mu + C'$, where $\lambda, \mu \geq 0$, and R is a fixed number. This is the extension to the scattering of spin particles, of a result obtained in the scalar case. As a first consequence, the Froissart limits are extended to all helicity amplitudes. Furthermore, it is shown that for $-t_0 \leq t \leq 0$ and s going to infinity, the regularized helicity amplitudes in the t channel, with initial (resp. final) helicities λ_1 and λ_2 (resp. μ_1 and μ_2), are bounded by: $Cs^{1-\mathrm{Max}(|\lambda|,|\mu|)} \log^2 s$, if $\lambda + \mu$ is even; and $Cs^{1-\mathrm{Max}(|\lambda|,|\mu|)} \log^3 s$, if $\lambda + \mu$ is odd, where $\lambda = \lambda_1 - \lambda_2$ and $\mu = \mu_1 - \mu_2$. This gives superconvergent amplitudes as soon as one of the spins is larger than one. The case of spin 0 – spin 1 scattering is marginal, and in the absence of any detailed dynamical information, one cannot obtain a superconvergent amplitude in that case. (auth)

8752 IS THE POMERANCHON AN ORDINARY REGGE TRAJECTORY? Harari, Haim (Weizmann Inst. of Science, Rehovoth, Israel). Lect. Theor. Phys.; 11-A: 553-73(1969).

From Conference on Particle Physics, Boulder, Colo. See CONF-680627-(Pt.1).

Some general remarks are presented concerning a possible relation between Regge poles and cuts and various optical models for high-energy hadron collisions. A specific model for the Pomeranchuk trajectory is discussed and an attempt is made to see whether it has a special diffractive character which distinguishes it from other trajectories. (L.B.S.)

8753 VARIATIONAL PRINCIPLE IN MATRIX ND^{-1} FORMALISM. Hori, Setsuko (Osaka Univ.); Kanki, Takeshi. Progr. Theor. Phys. (Kyoto); 42: 959-65(Oct 1969).

A variational formalism of matrix ND^{-1} method in a multichannel scattering is proposed. The exact N function reduces the variational functional to the scattering amplitude, and an approximate solution with any trial N is symmetric and has correct left-hand singularities but the unitarity is satisfied approximately. (auth)

8754 ON A GENERALIZED DISTRIBUTION OF THE POLES OF THE UNITARY COLLISION MATRIX. Ullah, Nazakat (Tata Inst. of Fundamental Research, Bombay). J. Math. Phys. (N. Y.); 10: 2099-2103(Nov 1969).

An expression for the joint distribution of the complex poles of the unitary collision matrix is derived for the single-channel case, which is valid for all values of the ratio of the width to the spacing. The derivation uses the statistical distribution of the parameters of the real R-matrix theory. It is found that unitarity gives rise to the statistical correlations between the width and the spacing of the collision matrix. It is shown that the distribution of the poles of the unitary collision matrix using Feshbach's unified theory of nuclear reactions is the same as the one obtained using R-matrix theory, provided a particular choice of the arbitrary boundary condition is made in the latter theory. A remark is made about the use of the random complex orthogonal matrix in the study of the parameters of the statistical collision matrix. (auth)

Particle Accelerators

Refer also to abstracts 7634, 7642, 7674, 7692, 8381, and 8832.

8755 (CERN-Trans-69-25) POSSIBILITY OF EXTRACTION OF POSITIVE PARTICLES BY DIVISION OF INTERNAL TARGETS TOWARD THE EXTERIOR OF THE RING OF THE IFVE SYNCHROTRON. Sapunov, Yu. M.; Frolov, A. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). Translated by A. Golovanoff (CERN, Geneva, Switzerland), from report IFVE-68-69. 16p. (In French). Dep. CFSTI (U. S. Sales Only).

Diagrams are examined for the ejection of proton beams and beams of secondary particles elastically scattered from internal targets in the direction of transport channels for negative particles and external ejection of the primary proton beam. In spite of their concrete type these diagrams give a sufficiently complete representation of the principal possibilities for ejection of the positive particles toward the exterior of the IHEP accelerator ring. Calculation for the particle trajectories and the beam focusing in the accelerator magnetic field as well as an estimation of the external magneto-optical systems were carried out by computer with the help of special programs. (J.F.P.)

8756 (CONF-690301–, pp 23-31) PROCESSING AND OPTIMIZING NUCLEAR EXPERIMENTS IN COMPUTER ENVIRONMENT. Ferguson, A. J. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.).

Multiparameter event-by-event recording has become the major mode for data accumulation in the PDP-1 computer associated with the Chalk River tandem accelerator. Since the accelerator operates 24 hours per day and since time sharing on the computer is not feasible a major bottleneck for playback has developed. This problem is to be met by the installation of a PDP-10 computer which includes a fast disk memory of 1.5×10^6 words. This memory will allow the accumulation of spectral data at rates of 600 events/sec. In the majority of cases a single playback will be sufficient to accumulate all the necessary data instead of the many that are now required. It is intended to simplify the programming by the use of the FORTRAN compiler in a system that allows rapid revision of programs and run time definability of memory space. The use of the computer for optimizing experimental procedures is reviewed. (auth)

8757 (CONF-690301–, pp 37-53) EXPERIENCE WITH A MULTI-COMPUTER MULTI-EXPERIMENT SYSTEM. Gemmell, D. S. (Argonne National Lab., Ill.).

The computer system that serves the 15-MeV tandem Van de Graaff and 4-MeV Dynamitron accelerators at Argonne National Laboratory is described and some examples of its use are given. The system contains three small computers (two ASI 2100 and one ASI 210) which are compatible in both hardware and software. One of these computers is on-line at each accelerator and one is used mostly in off-line applications. The three machines have some interconnections between them and in addition there is a link to the Argonne CDC 3600. A significant feature (especially at the tandem location) is the very wide variety of experiments to which the computer system is applied. As a consequence, the emphasis in software is placed upon the development of a large set of subprograms which can rapidly and flexibly be put together and called from simple Fortran main programs. (auth)

8758 (CONF-690301–, pp 54-8) DATA ACQUISITION AND ANALYSIS WITH A LARGE, 2nd GENERATION COMPUTER. Hiebert, J. C. (Texas Agricultural and Mechanical Univ., College Station).

An IBM 7094 computer system is presently being placed on-line at the Texas A & M Variable Energy Cyclotron facility. The IBSYS monitor has been modified to support a multiprogramming environment in which the data acquisition functions are handled automatically in the background while the user can either monitor the data acquisition or analyze previously acquired data. A significant feature of the system is that the data processing power of the 7094 permits the scientist to conduct experiments which require extensive analysis of the raw data to determine the course of the experiment. (auth)

8759 (CONF-690301–, pp 106-23) THE UNIVERSITY OF ROCHESTER NUCLEAR STRUCTURE RESEARCH LABORATORY ON-LINE COMPUTER SYSTEM. Cline, D. (Rochester Univ., N. Y.).

The N.S.R.L. on-line data acquisition system for the 10-MeV tandem Van de Graaff accelerator presently consists of two PDP-8 satellite computers operating as high speed data terminals to a PDP-6 time-shared central processor. The evolution of both the hardware and software used with the system are described. Some of the advantages, limitations, and possible improvements to the present system are discussed. Typical applications of the system are given. (auth)

8760 (CONF-690301–, pp 191-7) EXPERIENCE WITH THE WILLIAMS LABORATORY ON-LINE COMPUTER SYSTEM. Hobbie, Russell K.; Goodwin, Robert W. (Minnesota Univ., Minneapolis).

A CDC 3100 was installed in 1965 and has been used for all experiments since the accelerator became operational. Fast data access is obtained by a direct route to memory which is not under program control. The advantages and disadvantages of such a system are discussed. A 2500-word operating system reserves data arrays, loads relocatable programs, processes real-time inter-

rupts and provides typewriter control of program execution. For flexibility, all programs can be called either by other programs or by the control typewriter. Most user-written programs are in Fortran. Fortran programs can reference the data arrays reserved by the resident. A simple program storing system using the end of the library tape facilitates secondary computer use during long runs. Measurement of excitation functions has been almost completely automated with computer control of the accelerator energy. Improvements to the Digitek Fortran-II are described. (auth)

8761 (CONF-690301–, pp 212-17) AN OPERATING SYSTEM FOR THE BNL LOW ENERGY ACCELERATOR FACILITY COMPUTER. Auerbach, E. H.; Hind, Margaret; Martin, B. A.; Rogers, P. C. (Brookhaven National Lab., Upton, N. Y.).

The Data Taking and Computational Facilities for BNL's Low Energy Accelerator Facility consists of an SDS Sigma-7 together with data-collection and display stations of local design. The operating system for this complex is designed to provide the working physicist with easy access to the computer's data-handling capability as well as a wide degree of computational ability at the local station. The operating system, based on a part-time use of SDS's Batch Monitor, operates in a limited time-sharing environment. First priority is given to servicing the data-collection interfaces; such additional time as remains is allotted to other functions at the various stations. Modifications to the SDS-supplied monitor are minimized, and the technique for this is discussed. (auth)

8762 (CONF-690301–, pp 218-25) RAPID DATA ACQUISITION INTO MORE THAN 10^6 CHANNELS AT ORELA. Betz, N. A.; Reynolds, J. W.; Slaughter, G. G. (Oak Ridge National Lab., Tenn.).

A data acquisition system which combines the high data rates (to 10^4 events/second) made possible by the Oak Ridge Electron Linear Accelerator and the large number of channels (to 10^6) needed for multiparameter neutron cross section measurements has been designed and implemented. The system consists of a digital data multiplexer interface, a fixed head disk for channel and program storage designed specifically for rapid semi-random access of individual channels, a CRT with light pen for data examination, and a small fast general purpose computer (SEL 810B). Each experimental event is tested to determine whether it is to be ignored or mapped into a channel address whose contents are then incremented. The ability to access individual words from the disk allows the experimental events to determine which channels are read into core memory for updating. This avoids the constant manipulation of unwanted channels and allows easy handling in excess of 10^9 channel events/second (total number of channels times number of events/second) by the system. (auth)

8763 (CONF-690301–, pp 243-65) A COUPLED PDP-7/8 COMPUTER SYSTEM FOR THE YALE UNIVERSITY ELECTRON ACCELERATOR. Firk, F. W. K.; Baglin, J. E. E.; Madsen, D. W.; Phillips, T. W. (Yale Univ., New Haven, Conn. Electron Accelerator Lab.).

A description of the coupled PDP-7/8 computer system for control and data acquisition and processing for the Yale University electron linear accelerator is given. (W.H.K.)

8764 (CONF-690301–, pp 276-86) TRIANGLE UNIVERSITIES NUCLEAR LABORATORY TIME-SHARING COMPUTER SYSTEM. Roberson, N. R.; Poore, R. V.; Seibel, F. (Duke Univ., Durham, N. C. Triangle Universities Nuclear Lab., Durham, N. C.); Joyce, J. (North Carolina Univ., Chapel Hill. Triangle Universities Nuclear Lab., Durham, N. C.).

A description is given of the hardware configuration and of the monitor system which allows a DDP-224 with 16 K of memory to be used in a time sharing mode by two Van de Graaff accelerator laboratories for on-line data acquisition. The system allows background jobs among peripherals as well as the two user program partitions. The requirements for this system and the hardware and software which were obtained to meet these requirements is discussed. A modified memory increment channel will allow memory addition without the attention of the central processor. A second DDP-224 with 8 K of memory has been recently purchased and will be delivered in March, 1969. The planned integration of this new computer into the on-line system is described. (auth)

8765 (CONF-690301–, pp 299-304) NEUTRON SPECTROSCOPY, DATA ACQUISITION, AND ANALYSIS. Slagowitz, M.; Hahn, J.; Rainwater, J.; Havens, W. W. Jr. (Columbia Univ., New York).

The development of a system using a 775 ns cycle time, 16 bit EMR 6130 computer to take, store, display, and reduce data and allow for real time physicist–data interaction for time-of-flight neutron spectroscopy at the Columbia synchrocyclotron is described. (W.H.K.)

8766 (CONF-690301–, pp 305-11) A YEAR'S EXPERIENCE WITH A SMALL COMPUTER AT ORIC. Ludemann, C. A. (Oak Ridge National Lab., Tenn.).

An SEL 840A has been operating successfully at ORIC under an easy-to-use foreground-background system. Foreground operations include the transfer to data to and from a data acquisition equipment interface as well as a communications interface linked to an IBM 360/75 at ORNL's central computer facility. A combination of protect hardware and software prevents loss of data and destruction of the system through errors in Fortran background routines. Recently CPU core storage has been increased to 16K words and additional interrupt hardware has been installed. These modifications improve the system's ability to handle event-by-event data processing experiments. Experience dictates that such real time acquisition usage should not, if at all possible, eliminate background computational ability at a one-computer installation. (auth)

8767 (CONF-690301–, pp 312-20) THE MICHIGAN STATE UNIVERSITY CYCLOTRON COMPUTER FACILITY. Benenson, W.; deForest, R. A.; Au, R. F.; Bayer, D. L.; Merritt, W. E. (Michigan State Univ., East Lansing).

The Michigan State University Cyclotron Computer facility consists of a Scientific Data Systems Sigma-7 computer with a laboratory designed multi-purpose interface. The operating system is a time-sharing supervisor called JANUS which permits safe real-time operation. The computer is available to the laboratory staff 24 hours a day, and it is often serving as many as six users simultaneously. FORTRAN jobs including compiling can be run anytime and have an effective memory of 128k locations. On-line use of the computer is mainly particle identification or one to four parameter pulse height analysis. (auth)

8768 (CONF-690301–, pp 321-5) ARGONNE COMPUTER-CONTROLLED SCATTERING CHAMBER. Yntema, J. L. (Argonne National Lab., Ill.).

The 9 movable components of the 70-in. scattering chamber at the Argonne Tandem are controlled by the ASI-210 computer. The scattering chamber has 4 independent arms. The detector carrier on each of these arms can be moved radially to vary the distance from the detector to the target. The target changer allows space for 8 targets. The beam shutter and current integrator are also under computer control, as are 7 multichannel analyzers and the external memory. The latter is used for program storage, for data accumulation through 4 ADC's, and for the storage of data from the previous run. The 11 400-channel spectra from the previous run can be analyzed while the next run is in progress. Several programs now make use of the decision-making capabilities of the computer. One program allows the acquisition of an angular distribution with a preset accuracy. Another allows the scattering chamber to take coincidences between 3 pairs of detectors, to compute the appropriate angular positions for the 4 arms, to move the arms and avoid collisions between them, and to make certain that the detector units do not hit the collimator or interrupt the transmitted beam. (auth)

8769 (CONF-690301–, pp 326-32) THE OHIO STATE UNIVERSITY–IBM 1800 ON-LINE SYSTEM. Blatt, S. L.; Nichols, D. B.; Sinclair, J. W. D. (Ohio State Univ., Columbus. Dept. of Physics).

Design and operation of the IBM 1800 computer system for data acquisition and control applications at the Ohio State University Van de Graaff Accelerator are described. (W.H.K.)

8770 (CONF-690301–, pp 333-9) ANOTHER LOW ENERGY NUCLEAR PHYSICS ON-LINE DIGITAL COMPUTER FACILITY. LaSalle, R. A.; Kaufmann, H. (Florida State Univ., Tallahassee. Dept. of Physics).

An EMR 6130 digital computer has been installed on-line with the Tandem Van de Graaff Accelerator at Florida State University. The unique features of this computer include non-saturating integrated circuit logic, an asynchronous memory bus structure and 750 nsec memory modules with "by word" memory protection. The processor, a disc, a magnetic tape unit, a printer and a card reader are attached to one memory bus while all nuclear instrumentation is attached to the second memory bus. A 14" CRT display with light pen, a paper tape reader and punch and a teletype are provided on a direct I/O channel. All special purpose hardware is constructed of a mixture of T^2L and DTL I.C. logic utilizing both dual in-line wire wrap socket assemblies and circuit cards. (auth)

8771 (CONF-690301–, pp 354-66) COMPUTER SYSTEM FOR NEUTRON CROSS-SECTION MEASUREMENTS. Lopez, W. M. (Gulf General Atomic, Inc., San Diego, Calif.).

An on-line data acquisition and analysis system has been developed for use in neutron cross-section experiments with an electron linear accelerator facility. The system consists of a CDC-1700

computer and its associated equipment, a fast time-encoder channel, a dual-input multipurpose channel that accepts various plug-in modules, and an oscilloscope graphic display channel. All data input transfers are initiated by external interrupts and are processed by rapid input subroutines that are written in Fortran or symbolic language. The system has been applied to neutron time-of-flight measurements, and some typical results are described for measurements of the reactions (n,γ), (n,n'γ), and (n,p). (auth)

8772 (CONF-690301–, pp 367-74) PARASITIC USE OF AN ON-LINE COMPUTER-BASED DATA SYSTEM. Levin, J. S.; Kellogg, M. P.; Perkins, R. B.; Ritter, E. T. (Los Alamos Scientific Lab., N. Mex.).

The fringe benefits that can be derived from an on-line computer-based data system are illustrated. The example presented, a β-γ-γ angular correlation experiment to test time-reversal invariance, ran almost continuously for a period of 14 months. This was accomplished with only minimal interference with the system's primary function of supporting experiments on the two accelerators of the Los Alamos Tandem Accelerator. This illustration involves the functions of data acquisition, data filtering and recording, monitoring, real-time data reduction, and feedback to control the progress of the experiment. The on-line use of the SDS 930 as well as the use of the CDC 6600 for final reduction is described. (auth)

8773 (CONF-690301–, pp 375-9) A COMPUTER GENERATION'S EXPERIENCE WITH A TIME-SHARED MULTI-EXPERIMENT ON-LINE FACILITY. Brenner, A. E. (Harvard Univ., Cambridge, Mass. Dept. of Physics).

A time-shared data acquisition system for the Cambridge Electron Accelerator and the Harvard Cyclotron is described. The system consists of a PDP-1 computer with 32k core memory, 5 magnetic tape units, sequence break (interrupt) hardware, a high-speed data channel, a precision programmed scope and light pen, a teletype multiplexor with several teletypes, and the standard paper tape reader-punch and typewriter. (W.H.K.)

8774 (CONF-690301–, pp 413-16) COMPUTER SYSTEMS IN SACLAY'S CYCLOTRON EXPERIMENTS. Chaminade, R.; Faivre, J. C.; Lugol, J. C.; Pain, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

Three on-line computers are used. Two are PDP-8 computers, with 4K of twelve bit memory and a type 34D display. A DECtape TC01/TU55 is connected with one of them. The third computer is a C 90-10 (C II) with 16K of 12 bit memory and a moveable head disk with a capacity of 4 million characters and a transfer rate of 200 kc. In addition, a computer controlled multiple display and three light pens, one for each computer, were designed. An efficient method of increasing the capacity of these 12 bit computers when used as multichannel analyzers is described. The use of the PDP-8 computers in medium or small scale experiments using, for example, one or two telescope detectors, or a localizing detector, is discussed, and the use of the C 90-10 in large cyclotron experiments using 43 detectors is briefly outlined. (auth)

8775 (CONF-690301–, pp 472-6) SMALL COMPUTER AS AN INTERFACE. Moyer, W. R. (Rensselaer Polytechnic Inst., Troy, N. Y.).

The use of a large scale time-sharing computer for direct on-line data acquisition and experiment control can lead to subtle systematic errors in recorded data. Care must be exercised in the design of a data acquisition system to minimize cross-talk between simultaneous experiments. The introduction of a small computer as an interface between the experiment and the large multi-capacity system offers several advantages. A brief description of data handling at the Rensselaer Linear Accelerator is presented. (auth)

8776 (CONF-690301–, pp 516-27) REDUCTION OF NUCLEAR PHYSICS DATA IN REAL TIME WITH FORTRAN. Bevington, P. R. (Stanford Univ., Calif. Dept. of Physics).

The SCANS (Stanford Computers for the Analysis of Nuclear Structure) system utilizes a hybrid philosophy and technique developed for the reduction in real time of multichannel pulse-height spectra, which comprise the bulk of data in nuclear physics. The system combines the interactive response inherent in small scientific computers with the flexibility of Fortran, to provide ease in introducing and modifying sophisticated concepts such as non-linear least-squares fitting. Software interface to specific real-time hardware devices such as oscilloscope display and light pen is accomplished via library subroutines which perform a variety of general-purpose services. Several different applications of this approach to various types of data spectra are discussed to illustrate the degree of mutual interaction achieved between investigator and computer and the resultant optimization of reduction techniques to suit particular types of data. (auth)

8777 (DESY–69/44) PHYSICAL AND TECHNICAL LIMITATIONS OF STORAGE RING LUMINOSITY. Kohaupt, R. D.; Nesemann, H.; Piwinski, A. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Oct 1969. 25p. Dep. CFSTI (U. S. Sales Only).

The energy dependence of storage ring luminosity is investigated for variable crossing angle. The limiting effects are reviewed, described in a simplified model and compared with exact calculations, using DESY parameters. (auth)

8778 (KFK–1029) OPTIMIZATION OF HELIX ACCELERATORS. Schopper, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Aug 1969. 32p. Dep. CFSTI (U. S. Sales Only).

A systematic study of the optimization of a helix accelerator enables a better understanding of discrepancies in the literature and provides a new way of chosing the helix parameters. The losses in the helix are calculated in a more consistent manner from the sheath model. A high shunt impedance over a large range of particle momenta with comparatively few frequency jumps can be achieved. A helix accelerator seems to be useful for nucleon energies up to 200 MeV. A normal as well as superconducting helix is considered. The results are applicable to the acceleration of protons and heavy ions. (auth)

8779 (KFK-tr–297) FOCUSING OF A CHARGED ELECTRON RING IN THE COLLECTIVE ION LINEAR ACCELERATOR. Bonch-Osmolovskii, A. G.; Dolbilov, G. V.; Ivanov, I. N.; Perel'shteyn, E. A.; Sarantsev, V. P.; Yarkovoi, O. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by Rosemarie Corssen (Kernforschungszentrum, Karlsruhe, Ger.), from report JINR–P9-4135. 10p. (In German). Dep. CFSTI (U. S. Sales Only).

An abstract of this paper, prepared from the original language, appeared as NSA 23: 7202. (W.H.K.)

8780 (LA–4310) QUARTERLY STATUS REPORT ON THE MEDIUM-ENERGY PHYSICS PROGRAM FOR THE PERIOD ENDING OCTOBER 31, 1969. (Los Alamos Scientific Lab., N. Mex.). 1 Dec 1969. Contract W-7405-eng-36. 48p. Dep. CFSTI.

Operation of the Electron Prototype Accelerator is described and the development of the Los Alamos Meson Physics Facility is outlined. Linac structures, rf power systems, accelerator control and instrumentation, accelerator physics, the experimental area, the LAMPF users, LAMPF scheduling and facility construction, and physics research are discussed. (W.H.K.)

8781 (LAL–1224) REPORT OF ACTIVITY, MAY 1968–MAY 1969. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). Oct 1969. 105p. (In French). Dep. CFSTI (U. S. Sales Only).

Research and development projects at the Orsay Linac Laboratory from May 1968 to May 1969 are described. Operation of the linear accelerator and the ACO electron–positron storage ring are described, and progress on the multi-GeV Coppelia storage ring project is reported. Developments at the giant heavy-liquid bubble chamber Gargamelle are outlined including film analysis techniques. General instrumentation development is discussed, and nuclear and particle physics research summarized. Publications issued during the period are listed. (W.H.K.)

8782 (LIB/Trans–238) IMPORTANCE OF A CYCLOTRON FOR NUCLEAR MEDICINE AND BIOLOGY. Lorenz, W. J.; Scheer, K. E.; Lindner, H. W.; Chaudhri, M. A. Translated by U. Engelbert (Australian Atomic Energy Commission Research Establishment, Lucas Heights), from Atompraxis; 13: 251-4 (Jun 1967). 7p. Dep. CFSTI (U. S. Sales Only).

An abstract of this article, prepared from the original language, appeared in NSA 21: 46634. (Australia)

8783 (MNC–3783-4) ACCELERATION OF SUPER-HEAVY IONS AT THE MARYLAND CYCLOTRON: FEASIBILITY STUDY. Viola, V. E. Jr.; Gordon, G. E.; Reiser, M. P.; Woody, R. (Maryland Univ., College Park). Sep 1969. Contracts AT(40-1)-3783; AT(40-1)-3491. 60p. Dep. CFSTI.

As a result of the great current interest in the production of very heavy elements, the feasibility of constructing a super-heavy-ion accelerator at the University of Maryland has been investigated. It is concluded that by taking advantage of the unique features of the existing isochronous cyclotron, such an accelerator could be realized at Maryland at a low relative cost and in a minimum of time. Accelerator development would consist of two phases: (I) addition of an FN Tandem Van de Graaff to serve as an ion injector for the existing cyclotron, and (II) addition of a medium-stage cyclotron between the FN Tandem and final-stage cyclotron. Phase I permits the acceleration of ions as heavy as

lanthanum to energies in excess of 6 MeV/nucleon with corresponding beam intensities of at least 2×10^{12} particles/second. Addition of phase II makes possible a highly versatile facility with the capability of accelerating 3×10^{11} uranium ions/second to energies of 8 MeV/nucleon. In both phases higher energies and intensities are achieved for lighter ions. The costs are estimated at $3.67 M for phase I (including construction) and $3.10 M for phase II. Completion of phase I would require a minimum of 18 months and phase II would take another 24 months. As an alternative long-range approach, the possibility of achieving intense beams of the desired heavy ions by means of electron ring acceleration is discussed. The breadth of research made possible with such a facility is reviewed, giving special emphasis to the problems involved in heavy element synthesis. Finally, the capabilities for development of a super-heavy-ion accelerator at Maryland are summarized. (auth)

8784 (NCRP-31) SHIELDING FOR HIGH-ENERGY ELECTRON ACCELERATOR INSTALLATIONS. RECOMMENDATIONS OF THE NATIONAL COMMITTEE ON RADIATION PROTECTION AND MEASUREMENTS. (National Bureau of Standards, Washington, D. C.). 1 Jul 1964. 66p. (NBS-Handbook-97). GPO $0.30.

A summary of the presently available data required to calculate the shielding for high-energy high-intensity electron accelerator installations is presented. Accelerators with 0.5- to 100-MeV electron beam outputs up to 100 kW are considered. Accelerator beam characteristics and yields, radiation measurements, and the interaction of radiation with matter are discussed. (W.H.K.)

8785 (ORNL-4459, pp 32-5) SUPPORT FOR THE HIGH-VOLTAGE ACCELERATOR PROGRAM. (Oak Ridge National Lab., Tenn.).

The development and operation of the ORNL Van de Graaff accelerator are outlined. Topics include electron stripping of ions with carbon foils, measurement of tandem Van de Graaff accelerator terminal voltage, vacuum system and beam stripper installation, pulsed beam operation, ion source modifications, and scattering chamber development. (W.H.K.)

8786 (ORNL-4459, pp 36-9) SUPPORT FOR LINEAR ACCELERATOR DEVELOPMENT. (Oak Ridge National Lab., Tenn.).

Status of the Oak Ridge Electron Linear Accelerator (ORELA) development program is summarized. Topics include the development of a linear neutron filter assembly, beam-line equipment for flight path 7, and the personnel safety interlock system. (W.H.K.)

8787 (RHEL/R-185) CONSTRUCTION OF MAGNETS FOR PARTICLE ACCELERATOR PHYSICS USING CEMENTATIOUS AGGREGATES. Gresham, A. T.; Sheldon, R.; Stapleton, G. B. (Rutherford High Energy Lab., Chilton (England)). Sep 1969. 8p. Dep. CFSTI (U. S. Sales Only). UK 1s. 9d.

A technique is proposed for constructing synchrotron and other high energy physics magnets in an integral form using concrete both as an electrical insulator and as a mechanical support. Such structures will overcome the radiation problems encountered in synchrotrons and should prove to be economically attractive. (auth) (UK)

8788 (SLAC-Trans-107) DETERMINATION OF THE TRANSVERSE POLARIZATION OF HIGH-ENERGY ELECTRONS. Baier, V. N.; Khoze, V. A. Translated by T. Watt (Stanford Linear Accelerator Center, Calif.), from [Yadern. Fiz.;] 9: 409-12(1969). 10p. Dep. CFSTI.

Various possible experimental methods for determining the degree of transverse polarization of high-energy electrons in storage rings are briefly discussed. (W.H.K.)

8789 (UCRL-19213) HANDLING FIELD NONLINEARITIES IN THE BEVATRON RESONANT EXTRACTION. Allison, Robert W. Jr.; Grunder, H. A.; Lambertson, Glen R. (California Univ., Berkeley. Lawrence Radiation Lab.). 18 Aug 1969. Contract W-7405-eng-48. 17p. (CONF-690811-12). Dep. CFSTI.

From 7th International Conference on High Energy Accelerators, Moscow, USSR.

In the development of a resonant extraction system for the Bevatron it is necessary to consider the effects of the strong nonlinearities in the synchrotron guide field. The variation of particle oscillation frequency with amplitude and distortions from sinusoidal form have been analyzed. Effects on the resonant growth process have been calculated and observed. Guided by the analysis, it has been possible to achieve satisfactory behavior with only minor alterations of the guide field. Use of a small spill-control perturbation is discussed and performance of the extraction system is reported. (auth)

8790 SOME EXPERIMENTS IN FAST NEUTRON RADIOGRAPHY. Berger, Harold (CEN, Grenoble, France). Mater. Eval.; 27: 245-53(Dec 1969).

Accelerators that provide 3-MeV and 14-MeV neutrons have been investigated as sources for fast-neutron radiography. Detection methods employed include direct film methods with hydrogenous, metallic, and scintillator converters; transfer methods, such as copper activation for 14-MeV neutrons, and track-etch techniques with both polycarbonate and cellulose nitrate plastics. The best radiographic contrast for direct exposure methods was obtained with scintillator-film combinations; and for transfer methods, with copper screens. Both techniques gave similar contrasts for radiographs of rubber and plastic objects on steel or lead. However, the contrasts were not significantly different from those obtained by gamma and x-radiography. Therefore, it was concluded that fast-neutron radiography with these high-energy neutrons may not be generally useful. Promising special radiographic applications of these high-energy neutron generators include the possibilities of inspecting radioactive objects and that of proton radiography. (auth)

8791 METHOD OF DISASSEMBLING AN EVACUATED VESSEL. Fujita, Kyoichi (to Mitsubishi Heavy Industries Ltd.). Japanese Patent 1969-16080. 16 Jul 1969. Filed 23 Aug 1965.

A method is proposed for disassembling an evacuated vessel, such as that in a particle accelerator. The advantages are: reduction of time required to assemble the vessel again in high vacuum due to the reduced time for removing molecules adhered onto the surface, and also, prevention of corrosion of the vessel surfaces if the time between disassembly and re-assembly is short. Essentially, the method is to introduce gas having a large molecular radius and little moisture into the vessel and then to disassemble the vessel. The end of the vessel is closed with a metal foil sandwiched between flanges. To this end is attached a member to break the foil with a pointed rod and then introduce the gas having low moisture content. (NSA of Japan)

8792 INJECTOR FOR CYCLIC ELECTRON ACCELERATOR. Rybas, K. P.; Fidel'skaya, R. P.; Dezhnev, A. K.; Kuznetsov, V. S.; Telepaev, B. N.; Kiseleva, N. A. Elektrofiz. App., Sb. Statei; No. 6, 30-43(1967). (In Russian).

A comparison between the Kerst injector and the Pierce gun showed that the latter was preferable in every respect except for a focusing error of 5 to 6 mm. A new injector combining a Pierce gun with a 90°-angle inflector was developed and tested. The injector construction permits degassing at 400 to 500°C. A detailed drawing of the injector is supplied. Oscillograms show anode voltage, main-collector current, and auxiliary-collector current for several positions of that collector. The oscillograms permitted determining the width of monochromatic beam. Plots of beam current and beam emergence angle vs the ratio of inflector voltage to anode voltage are shown. The new injector yields high-intensity well-focused beams with an error of 2 to 3 mm. (JPRS)

8793 INVESTIGATIONS OF A NEUTRON TUBE ION SOURCE. Voytsik, L. R.; Erozolimskii, B. G. Tr., Vses. Nauch.-Issled. Inst. Yadern. Geofiz. Geokhim.; No. 1, 144-7 (1968). (In Russian).

Results of experiments carried out to clarify the possibilities of decreasing the dimensions of the ion source while retaining a sufficiently large ion stream in connection with the designing of pulsed neutron tube for borehole use are briefly reported. In the range of variation of working parameters of the ion source examination, there are definite values of length at which the regime of operation is optimum for a given diameter. It is possible to build an ion source 15 mm in diameter and 40 mm long which can give full current pulses of about 1,000 microamp. (Geophys. Abstr.)

8794 SOME PROBLEMS OF THE CONSTRUCTION OF PORTABLE ACCELERATOR TUBES. Ab, E. A.; Andrianova, G. M.; Plotnikov, R. I.; Khutsishvili, L. A. Tr., Vses. Nauch.-Issled. Inst. Yadern. Geofiz. Geokhim.; No. 1, 130-4(1968). (In Russian).

Portable sealed neutron tubes have been constructed with ionic irradiation units of arc type, yielding ion streams on the target with a force of several hundred microamps at voltages up to 130 kV and more. The diameter of the tubes is 16 to 40 mm, length 200 mm; neutron output is from 10^7 neutrons per sec for the smallest tube diameter to 10^9 neutron per sec for an ion source 30 to 32 mm in diameter. The tubes operate stably both in the pulsed and in the continuous regimes for different pulse duration and duty factor, and also can fulfill the function of a kenotron (with appropriate changes in construction). (Geophys. Abstr.)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 8790, 8793, 8794, 8883, and 9079.

8795 (AAEC/TM-517) SCATLD-360: AN EDITING PROGRAM FOR 360 GYMEA NEUTRON SCATTERING LIBRARIES. McGregor, B. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sep 1969. 47p. Dep. CFSTI (U. S. Sales Only).

SCATLD-360 is an editing program used to load 360 GYMEA neutron scattering libraries from cards, or from cards and another library. Whole libraries or selected sections can be printed or punched. (auth)

8796 (CISE-R-103) PRELIMINARY REPORT ON PULSED EXPERIMENTS FOR A TWO TEMPERATURE MODERATING MEDIUM. Topical Report No. 5. Accinni, F.; Palazzi, F.; Zorzoli, G. B. (Centro Informazioni Studi Esperienze, Milan (Italy)). Mar. 1964. 83p. Dep. CFSTI (U. S. Sales Only).

This report describes the preliminary work for thermalization measurements on a two temperature medium by means of the pulsed neutron technique. The experimental loop and the pulsed neutron source are described, and preliminary experimental data are also reported. (auth)

8797 (CTC-9) PMS1: A FORTRAN MONTE CARLO CODE FOR CORRECTING EXPERIMENTAL FAST-NEUTRON POLARIZATION DATA. Morrison, G. W.; Miller, T. G.; Gibson, F. P. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). 12 Dec 1969. Contract W-7405-eng-26. 32p. Dep. CFSTI.

A Monte Carlo Code was written to correct experimental fast neutron polarization data for finite geometry and multiple scattering effects, when liquid helium is the polarizer analyzer. The code uses phase shifts to calculate the necessary parameters, the angular distribution $d\sigma/d\Omega$, the polarization P and the spin rotation parameter β needed for consistent tracking of polarization effects in successive scatterings. The code adjusts the initial input polarization needed to reproduce the measured left-right ratio. (auth)

8798 (IEA-147) PULSED NEUTRON MEASUREMENTS IN WATER. Paiano, Myrian C.; Paiano, Silvestre (Instituto de Energia Atomica, Sao Paulo (Brazil)). Aug 1967. 25p. (CONF-670707-18). Dep. CFSTI (U. S. Sales Only).

From IAEA Symposium on Neutron Thermalization and Reactor Spectra, Ann Arbor, Mich.

The results of recent measurements of the thermal neutrons diffusion parameters of water using the pulsed neutron technique are presented. All measurements were done in cubic geometries with bucklings varying from 0.037 to 0.785 cm^{-2}. The effect of the aluminum walls of the containers was estimated in terms of an equivalent water thickness. The method used to correct the counting losses of the detector and counting system is presented. The decay curves were analyzed by a least squares method and care was taken of the influence, on the diffusion parameters, of various values for the extrapolation distance and of different weighting factors for the experimental points of the λ versus B^2 curve fitting. Results indicate that the weighting factors may have a considerable influence on the values of the diffusion constant and diffusion cooling coefficient. Furthermore, the comparison of experimental results with the ones obtained in experiments using flat and cubic geometries indicates that the shape effect on the diffusion parameters can be less important than has been considered. (auth)

8799 (KAPL-P-3849) IRRADIATED RADIUM-BERYLLIUM NEUTRON SOURCE BUILDUP. Kitchen, S. W.; Sherman, D. C. (Knolls Atomic Power Lab., Schenectady, N. Y.). Oct 1969. Contract W-31-109-eng-52. 21p. (CONF-691102-4). Dep. CFSTI.

From 17th Conference on Remote Systems Technology, San Francisco, Calif.

Large increases in neutron source strength as a result of irradiation by neutrons were first reported in 1958. Later experimental work irradiating sources in the Materials Test Reactor indicated that resonance absorption effects could be safely ignored. Consideration of the differences in neutron energy spectrum between the MTR and usual power reactors suggested that resonant absorptions could be significant in power reactors. Calculations over a range of neutron spectra show the source buildup factor to be several times as large for spectra typical of power reactors as that for purely thermal reactors. (auth)

8800 (ORO-3858-1) NEUTRON TRANSPORT THEORY CONFERENCE, JANUARY 20-24, 1969. (Virginia Polytechnic Inst., Blacksburg). 675p. (CONF-690108). Dep. CFSTI.

Separate abstracts were prepared for 25 of the 26 papers included. The remaining paper has previously appeared in NSA. (J.W.R.)

For abstracts of individual papers see: 8516, and 8801-8824.

8801 (ORO-3858-1, pp 1-35) SOME COMMENTS ON OBSERVABLE MODES AND PSEUDO-MODES IMBEDDED IN THE CONTINUOUS SPECTRUM OF THE LINEAR BOLTZMANN OPERATOR FOR THE WAVE AND POISONING PROBLEM. Dorning, J. J.; Thurber, J. K. (Brookhaven National Lab., Upton, N. Y.).

The fundamental solution for a linear Boltzmann equation having a collision frequency which depends linearly on the velocity, and for which the degenerate kernel approximation for the compact creation part of the collision operator is made, is given. By means of the method of analytic continuation it is found that discrete modes and pseudo-modes are imbedded in the continuous spectrum of the Boltzmann operator. Explicit asymptotic forms of the fundamental solutions are obtained. These results are used to resolve some controversies which exist in the neutron poisoning and high frequency sound-wave problems. Because of the simple form of the collision frequency which was assumed, methods of classical complex analysis suffice to give analytical as opposed to purely numerical solutions and much basic and detailed information concerning the nature and location of the singularities essential for an understanding of the Boltzmann equation was obtained. (auth)

8802 (ORO-3858-1, pp 36-75) PSEUDO-MODE SOLUTIONS OF THE INITIAL-VALUE PROBLEM OBTAINED BY ANALYTIC CONTINUATION: THERMAL AND FAST SYSTEMS. Dorning, J.; Nicolaenko, B.; Thurber, J. K. (Brookhaven National Lab., Upton, N. Y.).

Results of work which is still in progress on two related but different (thermal and fast) initial-value problems is reported. Some of the basic concepts of the method of analytic continuation are presented in detail in the initial discussion of the thermal pulsed-neutron problem. Using analytic continuation, the fundamental root (which bifurcates) of the dispersion relation is followed onto non-physical Riemann sheets. Knowing the locations of these bifurcated roots we are able to calculate by saddle point methods the dominant behavior of the unstable decay state (pseudo-mode). The initial-value problem for subcritical fast multiplying systems is examined. After reviewing the details of establishing the dispersion relation in terms of the Green's function of an auxiliary slowing-down operator, the Green's function is solved for and the motion of the root of the resulting dispersion relation on the physical and non-physical sheets is examined. Again, as in the thermal problem, nearby roots (the fundamental root n-furcates) on the sheets adjacent to the physical one enable us to determine the dominant pseudo-mode decay behavior. The dominant time-behavior when the root is located exactly at the branch point is also obtained by end-point evaluations (Watson's lemma) of the branch integrals. (auth)

8803 (ORO-3858-1, pp 76-119a) SOME MATHEMATICAL CONSIDERATIONS ON CAUCHY INTEGRALS RELATED TO PULSED NEUTRON DISPERSION RELATIONS. Dorning, J.; Nicolaenko, B.; Thurber, J. K. (Brookhaven National Lab., Upton, N. Y.).

A primary of mathematical methods of interest when dealing with Dispersion Relations, Analytic Continuations, Cauchy Integrals, "Pseudo-Modes," et al., is presented. A salient feature is the outline of a method to obtain the "Puiseux Expansion" of a Cauchy integral around its branch-point. Such an expansion, made with a set of simple multi-valued functions, has the good fortune to be valid in both physical and nonphysical Riemann sheets. (auth)

8804 (ORO-3858-1, pp 119b-36) SOME PROBABILISTIC RESULTS IN TRANSPORT THEORY. Mullikin, T. W. (Purdue Univ., Lafayette, Ind.).

Some applications of the theory of branching processes to problems in neutron transport theory are discussed. This amounts to considering the history of a single neutron as a random event. Statistics for these stochastic processes are calculated. For simple models, quantitative results are obtained while for realistic models, essentially qualitative results are obtained. (J.W.R.)

8805 (ORO-3858-1, pp 137-58) GENERATING FUNCTIONS IN TRANSPORT THEORY. Bareiss, Erwin H.; Abu-Shumays, I. K. (Argonne National Lab., Ill.).

It is shown that the stationary transport operator can be mapped one-to-one on an ultra-hyperbolic partial differential operator. Therefore, well posed problems for the P.D.E. can be mapped into well posed problems of the corresponding transport equation. The fundamental solutions for the homogeneous P.D.E. are also given. (auth)

8806 (ORO-3858-1, pp 159-77) HARMONICS IN TRANSPORT THEORY. Birkhoff, Garrett; Abu-Shumays, Ibrahim K.

Analytical procedures for improving the diffusion approximations to transport problems are described. Harmonic solutions to transport equations are obtained by the procedures. (J.W.R.)

8807 (ORO-3858-1, pp 178-205) CASE EIGENFUNCTIONS AND THE THEORY OF ORTHOGONAL POLYNOMIALS. Inoenue, E. (Princeton Univ., N. J.).

A connection between the Case eigenfunctions for one-dimensional one-speed transport problems and the theory of orthogonal polynomials is pointed out. This connection provides another view of the orthogonality and completeness of these eigenfunctions, allows one to derive some interesting relations which are particularly useful for the treatment of anisotropic scattering and suggests new approximate schemes. (auth)

8808 (ORO-3858-1, pp 206-20) NUMERICAL STUDIES OF THE INITIAL-VALUE PROBLEM FOR THE ONE-VELOCITY NEUTRON TRANSPORT EQUATION WITH DELAYED NEUTRONS SLAB GEOMETRY. Hendry, W. L. (Los Alamos Scientific Lab., N. Mex.); DeMuth, N. S. (New Mexico Univ., Albuquerque. Dept. of Nuclear Engineering).

A preliminary report on efforts to obtain numerical solutions to the initial-value problem for the one-velocity neutron transport equation with delayed neutrons in slab geometry is presented. Work is currently proceeding along two lines: numerical methods based on the exact analysis of Kaper and of Mika; and those based on analytic treatment of the equations resulting from the application of the method of matched asymptotic expansions. The latter approach is emphasized here. (auth)

8809 (ORO-3858-1, pp 221-58) SPATIAL DIFFERENCING OF THE TRANSPORT EQUATION: POSITIVITY VS. ACCURACY. Lathrop, K. D. (Los Alamos Scientific Lab., N. Mex.).

The problem of the positivity of the solution for the finite difference form of the discrete ordinates equations is discussed. Finite difference techniques which ensure positive solutions are examined. It is shown that the positive schemes pay a price in accuracy to ensure positivity. (J.W.R.)

8810 (ORO-3858-1, pp 259-76) AN ALTERNATE DIRECTION: DISCRETE ORDINATES METHOD. Carlson, Bengt G. (Los Alamos Scientific Lab., N. Mex.).

The formulation and application of the discrete ordinates method in neutron transport theory is surveyed. The discussion includes the construction of suitable quadrature sets, the construction of difference schemes, and the development of methods for promoting the faster convergence of the iterative processes. (J.W.R.)

8811 (ORO-3858-1, pp 277-88) NUMERICAL SOLUTION OF THE TRANSPORT EQUATION. Bowden, R. L.; Bullard, A. G. (Virginia Polytechnic Inst., Blacksburg. Dept. of Physics).

The procedure for numerically analyzing the singular integral transport equation for a critical slab is outlined. (J.W.R.)

8812 (ORO-3858-1, pp 289-323) TIME DEPENDENT MONOENERGETIC NEUTRON TRANSPORT IN A FINITE SLAB WITH INFINITE REFLECTORS. Newman, Perry A. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center); Bowden, Robert L. (Middle East Technical Univ., Ankara (Turkey)).

The initial-value transport problem of monoenergetic neutrons migrating in a thin slab surrounded by infinitely thick reflectors is investigated using the normal-mode expansion technique of Case. The results obtained to date indicate that the reflector gives rise to a branch-cut integral type term typical of a semi-infinite medium, while the central slab may contribute a summation over discrete residue type terms. Exact expressions are obtained for these discrete time eigenvalues and numerical results are presented showing the behavior of real time eigenvalues as a function of the material properties of the slab and reflector. When the reflector becomes a vacuum, the eigenvalues tend to those previously reported by Bowden. Some questions which remain concern the deformation of the integration contour of the inverse Laplace transformation. (auth)

8813 (ORO-3858-1, pp 324-30) INVARIANT IMBEDDING FROM THE POINT OF VIEW OF CASEOLOGY. Zweifel, P. F. (Virginia Polytechnic Inst., Blacksburg, Va. Dept. of Physics).

A new derivation of the invariant imbedding equations based on the Case eigenfunction expansion is presented. The method is mathematically rigorous and avoids the undesirable features of previous approaches. (J.W.R.)

8814 (ORO-3858-1, pp 331-55) SOME APPLICATIONS OF THE TRANSFER MATRIX APPROACH. Aronson, Raphael (New York Univ., N. Y.).

The application of the transfer matrix approach to various one-speed problems in plane geometry with arbitrary differential scattering cross sections is discussed. Some numerical results are examined. (J.W.R.)

8815 (ORO-3858-1, pp 356-79) NEUTRON WAVE OPTICS. Mockel, Andre J. (Florida Univ., Gainesville. Dept. of Nuclear Engineering Sciences).

It is shown that a transfer matrix can be constructed for the wave reflection and transmission coefficient. The problem of finding these coefficients is formulated in two ways, one in terms of Case's eigenfunctions, and the other in terms of invariant imbedding equations. (J.W.R.)

8816 (ORO-3858-1, pp 380-414) RELAXATION PROBLEMS IN NEUTRON TRANSPORT AND IN THE KINETIC THEORY OF GASES. Kuscer, Ivan (Cornell Univ., Ithaca, N. Y.).

Relaxation problems for thermal neutrons in a moderator, as well as for a slightly disturbed single gas, are reviewed. The problem with bounded geometry is analyzed in detail, in particular the single-gas case with its more difficult boundary condition. Under the simplifying restriction to isotropic scattering the qualitative picture of the eigenvalue spectrum for this case is determined by methods borrowed from the corresponding neutron problem. (auth)

8817 (ORO-3858-1, pp 498-529) NEUTRON TRANSPORT IN MORE THAN ONE DIMENSION. Erdmann, R. C. (California Univ., Los Angeles).

Two methods for solving two- and three-dimensional problems in transport theory are described. An iteration procedure is developed for solving finite slab problems via the integral transport equation. The elementary solution method is applied to the finite slab and quarter space problems described by an integro-differential transport equation. This latter method, based on generalized analytic function theory, appears sufficiently based to find wide application. (auth)

8818 (ORO-3858-1, pp 530-41B) TWO DIMENSIONAL SINGULAR INTEGRAL EQUATIONS IN TRANSPORT THEORY. Ferziger, Joel H. (Stanford Univ., Calif. Nuclear Engineering Lab.).

The method of two dimensional singular integral equations in linear transport theory is described. The method is compared with other methods and some problems which can be treated by the method are described. (J.W.R.)

8819 (ORO-3858-1, pp 542-86) GREEN'S FUNCTIONS FOR MULTIDIMENSIONAL NEUTRON TRANSPORT IN A SLAB. Leonard, A.; Garrettson, G. (Stanford Univ., Calif. Dept. of Mechanical Engineering).

The Green's function for all two- or three-dimensional source distributions in a one-dimensional slab is determined. The integral transport equation is reduced to a one-dimensional integral equation with a difference kernel depending parametrically on the transform variables. A complete solution to this reduced equation is then found. (J.W.R.)

8820 (ORO-3858-1, pp 587-606) NEUTRON TRANSPORT IN ARBITRARY CONVEX GEOMETRY-II. Gibbs, Alan G. (Battelle Memorial Inst., Seattle, Wash.).

The general replication formalism for solving the one-group integral transport equation in arbitrary convex geometry is reviewed and some refinements and extensions are reported. Specifically, it is shown 1) how a simpler set of Fredholm equations for the expansion coefficients of the neutron density may be obtained, 2) how the representation of the neutron density changes under transformations of the basis functions, and 3) how the representation of the density is related to the adjoint of the singular integral equation satisfied by the expansion coefficients. (auth)

8821 (ORO-3858-1, pp 607-39) SOME RESULTS IN ONE- AND TWO-DIMENSIONAL TRANSPORT THEORY. McCormick, N. J. (Washington Univ., Seattle. Dept. of Nuclear Engineering).

A short introduction into the use of orthogonality relations in

one-dimensional neutron transport problems is presented, together with new orthogonality relations for treating multi-media infinite lattice problems in plane geometry is described. A second application of the new orthogonality relations investigates the importance of anisotropic scattering when determining critical thicknesses of slabs which are surrounded by infinite reflectors. A summary is also presented of current work underway on a two-dimensional quarter–space problem in which a source is assumed to be imbedded deep within the medium. The objective of the analysis is to obtain numerical results for the extrapolation distance near the corner of the medium. The approach is based upon the procedure developed by Gibbs and utilizes the replication properties of a basis set for the two-dimensional quarter–space geometry. (auth)

8822 (ORO-3858-1, pp 640-52) INVARIANT IMBEDDING METHOD FOR CURVED GEOMETRIES. Mingle, J. O. (Kansas State Univ., Manhattan).

An introduction to the invariant imbedding method for curved geometries is presented by considering the reflection function for a sphere. The derivation is shown and some suggestions are given as to the type of numerical solution which might be attempted. (auth)

8823 (ORO-3858-1, pp 653-67) SPHERICAL MILNE PROBLEM. Smith, O. J. (North Carolina State Univ., Raleigh).

A solution is sought for the particle density in an infinite, nonabsorbing medium surrounding a black sphere, with the source of radiation originating at infinity. This is analogous to the classical Milne problem in plane geometry. A transform technique is used which readily reduces the transport integral equation to a rapidly converging Fredholm equation for the expansion coefficients. (J.W.R.)

8824 (ORO-3858-1, pp 668-75) NEUTRON TRANSPORT IN MAGNETIC MATERIALS. Lingus, C. (Virginia Polytechnic Inst., Blacksburg, Va. Dept. of Physics).

The effects of magnetic scattering on the transport of neutrons are considered. From the results of this study, it seems possible that magnetic effects could prove to be useful in controlling neutron transport. (auth)

8825 (SRRC-35/69) MULTIGROUP NEUTRON TRANSPORT EQUATION IN THE DIFFUSION AND P_1 APPROXIMATION. Obradovic, D. (Strathclyde Univ., Glasgow (Scotland). Dept. of Mechanical Engineering. Scottish Research Reactor Centre, East Kilbride (Scotland)). [1969]. 31p. Dep. CFSTI (U. S. Sales Only).

Investigations of the properties of the multigroup transport operator, with and without delayed neutrons in the diffusion and P_1 approximation, is performed using Keldis's theory of operator families as well as a technique recently used for investigations into the properties of the general linearized Boltzmann operator. It is shown that in the case without delayed neutrons, the multigroup transport operator in the diffusion and P_1 approximation possesses a complete set of generalized eigenvectors. A formal solution to the initial value problem is also given. (auth)

8826 BRANCHING PROCESSES IN NEUTRON TRANSPORT THEORY. Mullikin, T. W. (Purdue Univ., Lafayette, Ind.). pp 199-281 of Probabilistic Methods in Applied Mathematics. Vol. I. Bharucha-Reid, A. T. (ed.). New York, Academic Press Inc., 1968.

A mathematical model for neutron transport is presented in which the entire population resulting from a single initial neutron is considered as a random event. The results are cast in the framework of the Galton-Watson branching process and its generalizations. A distinctive feature of this approach is that the neutron population size is given as a function of generation number rather than of time. (J.W.R.)

8827 TOTAL NEUTRON–PROTON SCATTERING CROSS SECTION OF YTTRIUM HYDRIDE. Vorderwisch, P.; Wasserroth, K. (Hahn-Meitner-Institut, Berlin). Atomkernenergie, 14: 370 (Sept.-Oct, 1969). (In German).

8828 PRODUCTION OF COLLIMATED MONOENERGETIC BEAMS OF NEUTRONS FROM 2 TO 14 MeV BY THE ASSOCIATED PARTICLE METHOD. Schuster, D. G. (Univ. of Wisconsin, Madison). Nucl. Instrum. Methods; 76: 35-42(1969).

The associated particle method was used with the $D(d,n)^3He$ reaction at incident deuteron energies up to 14 MeV to produce collimated beams of neutrons whose energy could be varied from 2 to 14 MeV. The neutrons are in general polarized. At a neutron energy of 8.5 MeV, the neutron beam had an angular width of 5°, the coincidence timing resolution was 3.5 ns, and the neutron beam intensity was 1100 s^{-1} msr^{-1} with a 0.5 μA deuteron beam. (auth)

8829 SMALL UNG-1 NEUTRON TUBE. Bespalov, D. F.; Mints, A. Z.; Shkol'nikov, A. S. Tr., Vses. Nauch.-Issled. Inst. Yadern. Geofiz. Geokhim.; No. 1, 134-43(1968). (In Russian).

The UNG-1 tube (an all purpose neutron, gas-filled tube) was designed for use as a borehole source of neutrons in IGN-1 and IGN-1-M instruments (pulsed neutron source). It represents the first commercial accelerating tube for logging purposes produced in the Soviet Union (production began in 1963). The ion source is a Penning type, but with a hot cathode rather than cold. This permits lowering the supply voltage of the anode source and also the voltage of the magnetic field (by a factor of 5). The hot cathode makes it possible for the tube to serve both as ion accelerator and as high-voltage kenotron. The target is a thin layer of Ti on an Mo substrate, and the whole target is saturated with tritium. The tube is compact and is of simple construction. It has strongly mounted components, particularly the ion source, has a high-voltage electrode and target, and is not heavy. The glass bulb of the tube is 32 mm in diameter, the base 35 mm; the length is 185 mm, and the weight is 110 g. It operates at a pressure of 2 to $5 \cdot 10^{-4}$ mm Hg, an acceleration velocity of 60 to 100 kV, a magnetic field of 100 to 150 oersteds, and a pulse period of 400 seconds. In a pulsed regime, the neutron yield is 2 to $5 \cdot 10^7$ neutrons/sec, and the life is in excess of 100 hours. (JPRS)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstracts 8364, 8614, and 8828.

8830 (BMwF-FBK-69-33) EXACT UPPER AND LOWER BOUNDS FOR THE BINDING ENERGY OF THE TRITON WITH SOFT-CORE POTENTIAL. Ziegelmann, H. (Tuebingen Univ. (West Germany). Institut fuer Theoretische Physik). Oct 1969. 85p. (In German). Dep. CFSTI (U. S. Sales Only).

The accuracy of Hackenbroich's approximation in the Jastrow factor, the flexibility of the trial function and the importance of nonsymmetric functions are tested in the case of the triton and generalized to the α-particle. A procedure was developed to calculate separately the contributions of different regions of configuration space to the gap between upper and lower bounds. So one obtains information which clearly shows, where the trial function should be improved and which allows a very precise estimation with respect to the eigenvalue. (auth)

8831 (ORNL-tr-2236) ENERGY DEPENDENCE OF THE INTERACTION CROSS SECTIONS OF π-MESONS WITH ATOMIC NUCLEI AT ENERGIES HIGHER THAN 50 MeV. Barashenkov, V. S.; Gudima, K. K.; Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). Translation of report JINR-P2-4520. 9p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 42558.

8832 (UCLA-10-P-18-13) RESEARCH PROGRAM OF THE NUCLEAR CONSORTIUM AT THE UCLA CYCLOTRON LABORATORY. Report AR 4. Richardson, J. Reginald; Wright, Byron T. (California Univ., Los Angeles. Dept. of Physics); Louisell, William H. (University of Southern California, Los Angeles. Dept. of Physics); Eisberg, Robert M. (California Univ., Santa Barbara. Dept. of Physics). July 1969. Contracts AT(11-1)-Gen-10; AT-(04-3)-136; AT(11-1)-34. 89p. Dep. CFSTI.

BERYLLIUM-9—proton reactions (p,pα) at 47 MeV, proton spectra from, (E)
BISMUTH-209—proton reactions (p,2p) at 44 MeV, proton spectra from, (E)
CYCLOTRONS—research program at UCLA
—beam transport system for UCLA, design of high-resolution
—experimental facilities at UCLA, design of magnetic energy-loss spectrometer
FLUORINE-19—proton reactions (p,He-3) and (p,t) at 45 MeV, angular distributions for, (E)
HELIUM-4—proton reactions (p,He-3) and (p,t) at 117 MeV, PWBA analysis of, (T)
—proton elastic scattering at 31, 46, and 55 MeV, optical-model analysis of, (T)
IRON-56—proton reactions (p,2p) at 46 MeV, proton spectra from, (E)
NEON-20—proton reactions (p,pα) at 47 MeV, proton spectra from, (E)
NICKEL-58—proton reactions (p,t) at 23 to 40 MeV, excitation function for, (E)
OXYGEN-16—proton elastic and inelastic scattering at 20 to 40 MeV, excitation function for, (E)

—proton reactions at 20 to 40 MeV, excitation functions for, (E)
—proton reactions (p,pα) at 47 MeV, proton spectra from, (E)
PROTON BEAMS—energy measurement of, techniques for
RADIATION DETECTORS, SEMICONDUCTOR (SILICON)—use of stacked lithium-drifted, for measurement and elimination of nuclear reaction tails
SCANDIUM-45—proton reactions (p,Li-6) and (p,Li-7) at 46 MeV, energy spectra from, (E)
SPECTROMETERS—design of magnetic energy-loss, for UCLA cyclotron
TRITIUM—proton reactions (p,d)α and (p,d)np at 30 MeV, deuteron spectra and angular distributions for, (E) (T.W.R.)

8833 EVIDENCE FOR BROAD RESONANCES IN THE THREE-NUCLEON SYSTEM. Williams, L. E. (Rutherford High Energy Lab., Chilton, Eng.); Batty, C. J.; Bonner, B. E.; Tschalaer, C.; Benoehr, H. C.; Clough, A. A. Phys. Rev. Lett., 23: 1181-4(Nov. 17, 1969).

Evidence for broad resonances in ^{3}He and the three-proton system was observed in the continuum neutron spectra from the reactions ^{3}H(p,n) and ^{3}He(p,n) at 30 and 50 MeV. The positions and widths of possible resonances in the three-nucleon system were calculated using a variational method. A comparison is made with data from photonuclear reactions. (auth)

8834 STUDY OF THE REACTION ^{4}He(γ,2p2n). Gorbunov, A. N. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 10: 469-71(Sept. 1969). (In Russian).

Effective cross section of the reaction ^{4}He(γ,2p2n) and proton energy spectra are measured by means of the Wilson chamber. Data are obtained on the yields of main photonuclear processes on the ^{4}He nucleus. (auth)

8835 RE-DETERMINATION OF THE β-ENERGY OF TRITIUM AND ITS RELATION TO THE NEUTRINO REST MASS AND THE GAMOW–TELLER MATRIX ELEMENT. Salgo, R.; Staub, H. H. (Univ., Zurich). Nucl. Phys.; A138: 417-28(1969).

The upper energy limit of the β-particles of ^{3}H is determined with a retarding field spectrometer. Without having to rely on any assumptions concerning the structure of the source or of the resolving power of the instrument, an upper limit (80% confidence) of 200 eV for the rest mass of the antineutrino or its Fermi energy is found. Assuming that this mass is actually zero, a value for the maximum β-energy of 18.72 ± 0.05 keV is found. The corresponding ft value is 1159 ± 11 s. This result together with the very much lower half-life of the neutron by Christensen et al., gives a value of the square of the GT matrix element of 2.84 ± 0.06. This practically removes the discrepancy with the prediction of the PCAC hypothesis concerning the enhancement of the GT matrix element by pion exchange. (auth)

8836 POLE APPROXIMATION IN INTEGRAL EQUATIONS FOR FOUR PARTICLES. Narodetskii, I. M. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 10: 657-67(Sep 1969). (In Russian).

The pole approximation for the Faddeev–Yakubovsky equations for four particles, corresponding to the separation of the three-particle cluster, is considered. The equations are obtained with account of the spin and isospin variables for the case S = T = 0. The kernels of these equations contain three-particle one-channel Faddeev functions. Relations of these functions to ones obtained by means of the K-harmonics method are discussed. It is shown that if one takes for the three-particle subsystem the harmonics with K = 0, then the equation describing the excited state of He^4 contains only the experimental quantities: the binding energy and the charge form factor of tritium. (auth)

8837 EFFECTS OF SHORT-RANGE NUCLEON–NUCLEON CORRELATIONS IN THE ELASTIC ELECTRON SCATTERING BY LIGHT NUCLEI. Ciofi Degli Atti, C. (Istituto Superiore di Sanita, Rome. Istituto Nazionale di Fisica Nucleare, Rome); Grypeos, M. E. Nuovo Cim., Lett., 2: 587-94(Oct. 21, 1969).

Various approaches for investigating the effect of short-range dynamical correlations in electron elastic scattering are compared, and certain inadequacies and errors in some of them are pointed out. A systematic comparison is made by applying the approaches to elastic electron scattering by ^{4}He. It is shown that many-body correlations should not be neglected in any of the methods. (J.W.R.)

8838 A CALCULATION FOR THE ^{5}Li $\frac{3}{2}^+$ RESONANT STATE. Heiss, P.; Hackenbroich, H. H. (Univ., Cologne). Phys. Lett., 30B: 373-5(Nov. 10, 1969).

In the framework of the refined cluster model a two channel calculation for the ^{5}Li $\frac{3}{2}^+$ state was performed. The coupling of the channels is shown to be responsible for the ^{4}He-p $D_{\frac{3}{2}}$ resonance. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 8557, 8691, 8831, and 8832.

8839 (FEI–155) CROSS SECTIONS OF THE FORMATION OF GAMMA QUANTA IN THE REACTION (n,n′γ) IN FLUORINE, COBALT, ANTIMONY, AND TANTALUM NUCLEI. Broder, D. L.; Gamalii, A. F.; Lashuk, A. I.; Nesterov, B. V.; Sadokhin, I. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1969. 24p. (In Russian). Dep. CFSTI (U. S. Sales Only).

A semiconductor Ge(Li) detector was used to measure the gamma spectra arising from inelastic scattering of neutrons on ^{19}F, ^{59}Co, Sb, and ^{181}Ta nuclei. The following energies were found for the gamma-quanta from the respective nuclei: For ^{19}F, 110 ± 1 and 200 ± 1 keV; for ^{59}Co, 1095 ± 2, 1190 ± 2, 1280 ± 2, and 1400 ± 2 keV; for Sb, 153 ± 1 keV; and for ^{181}Ta, 137 ± 2, 153 ± 2, 163 ± 2, 302 ± 2, and 482 ± 1 keV. The cross sections of formation of these gamma-quanta in the process of nonelastic neutron scattering is determined. Results are compared with those of other authors and recommended curves are shown for the gamma-quanta formation cross sections. (auth)

8840 (JINR–P2-4788) CROSS SECTIONS OF LIGHT NUCLEI SPLIT BY HIGH-ENERGY PROTONS. Abdinov, O. B.; Barashenkov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 9p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Splitting of ^{12}C and ^{16}O, with the production of isotopes which are of interest for some applied problems of nuclear physics, has been calculated by the intranuclear cascade model. The decay of the highly excited residue nucleus, produced after the cascade stage of the process, was considered using the Fermi statistical theory. The results agree with the available experimental data. (auth)

8841 (JINR–P15-4745) EXCITED STATES OF NUCLEI IN NEGATIVE MUON CAPTURE BY CARBON AND OXYGEN. Budyashov, Yu. G.; Zinov, V. G.; Konin, A. D.; Medved, S. V.; Mukhin, A. I.; Ozerov, E. B.; Chatrchyan, A. M.; Eramzhyan, R. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1969. 20p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The probability of the excited nuclear level production in negative muon capture by carbon and oxygen nuclei was investigated. The energy of the γ ray and transition time dependence after the muon stop was measured with NaI(Tl) detector. The partial capture rate to the 1^- and 2^- state of ^{12}B* and the total capture rate to all the ^{12}B* excited bound states in the μ^- capture by ^{12}C for the reaction $^{12}C + \mu^- \rightarrow {}^{12}B^* + \nu$ have been determined. The yield of 2.13 MeV γ rays which follow the reaction $^{12}C + \mu^- \rightarrow {}^{11}B^* + n + \nu$ was measured. In the experiment on μ^- capture in ^{16}O for the reaction $^{16}O + \mu^- \rightarrow {}^{15}N^* + n + \nu$ the sum capture rate to the ^{15}N* even parity excited bound states and the capture rate to the $\frac{3}{2}^-$ state of ^{15}N* were determined. The total capture rate to all the excited bound states of ^{15}N* was determined also. Some of the results disagree essentially with theoretical predictions. (auth)

8842 MOMENT OF ATOMIC NUCLEUS. INVESTIGATIONS IN SHORT-LIVED LEVEL OF ATOMIC NUCLEUS. Sugimoto, Kenzo (Osaka Univ.). Kagaku (Tokyo), 39: 247-54(May 1969). (In Japanese).

Investigations on moments of atomic nuclei, especially magnetic dipole moments, are reviewed. The molecular beam method and nuclear magnetic resonance, which allow precise determination of magnetic moments for almost all the stable nuclei, are not applicable to an unstable nucleus of lifetime less than a few seconds. Angular correlations of cascade emission are successfully used to measure the magnetic moment of a nucleus with lifetime of $10^{-8} \sim 10^{-9}$ sec. A method for measuring the moments of nuclei with intermediate lifetime was recently developed. Polarization of a nucleus by bombardment with a high-energy particle is maintained long enough to detect the asymmetry of β-emission, which is lost when the resonant h.f. field is superposed on the static magnetic field. Magnetic moments of ^{17}F (life $T_{\frac{1}{2}}$ = 66 sec), ^{12}B ($T_{\frac{1}{2}} = 2.0 \times 10^{-2}$ sec) and ^{12}N ($T_{\frac{1}{2}} = 1.1 \times 10^{-2}$ sec) were measured by the method. Suitable conditions for the maintenance of nuclear polarization are discussed. Attention is given to moments of mirror nuclei, of which one is unstable, and the tendency of pairing of the same nucleons is pointed out. (NSA of Japan)

8843 ^{6}Li AND ELECTRON SCATTERING. Suzuki, Toshio (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto), 42: 24-35 (July 1969).

The form factor for the excitation of the 3.56-MeV level in ^{6}Li by electron scattering is calculated with an oscillator cluster model. The transition to the 3.56-MeV level occurs with spin- and isospin-flip of the cluster in ^{6}Li through the transverse component, while to the 2.18-MeV level changes the relative motion between clusters mainly through the longitudinal component of the electromagnetic interaction. The cluster model, when combined with the previous result obtained by Kudeyarov et al., can systematically reproduce all the experimental form factors for these inelastic electron scatterings and elastic scattering. From resulting parameters of the wave function for the 3.56-MeV level, it is concluded that the α and singlet deuteron clusters at this level are rather isolated in just the same way as the α and triplet deuteron clusters in the ground state. (auth)

8844 MEASURING CROSS SECTIONS OF INELASTIC SCATTERING OF 2.8-MeV NEUTRONS BY MEANS OF A SCINTILLATION DETECTOR INSENSITIVE TO γ RAYS. Prokopets, G. A.; Strizhak, V. I. (Kiev State Univ.). Ukr. Fiz. Zh., 14: 330-3 (Feb. 1969). (In Russian).

Cross sections of inelastic scattering of σ_n, neutrons at 2.8 MeV scattered by F, Al, Cu, Fe, and Pb were measured by inverse spherical geometry and using a scintillation detector insensitive to γ rays. Data obtained were tabulated. (R.V.J.)

8845 APPLICATION OF AVERAGED POTENTIALS OF NUCLEAR OPTICAL MODEL TO DESCRIPTION OF 14-MeV NEUTRON INELASTIC SCATTERING BY NUCLEI OF C, N, Mg, S, Mo, Ag, Cd, Te, Hg, AND Bi. Strizhak, V. I.; Korbetskii, E. V.; Sokolov, L. S. (Kiev State Univ.). Ukr. Fiz. Zh., 14: 342-3(Feb. 1969). (In Russian).

Experimental data on differential cross sections of inelastic scattering of neutrons at energies of 14 MeV were correlated with cross sections estimated by the optical model with Woods–Saxon potential for the virtual part and as a derivative of the virtual part in the imaginary part. Data obtained are tabulated. In the case of carbon and nitrogen both potentials disagree with the experiment while for the heavy nuclei (Ag, Hg, and Bi) the experimental and theoretical data are in good agreement. (R.V.J.)

8846 ON MECHANISM OF REACTION ^{16}O(d,α)^{14}N. Alvesh, M. S.; Vasil'eva, O. I.; Nadtochii, V. G.; Spasskii, A. V.; Teplov, I. B.; Fateeva, L. N. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz.; 10: 481-4(Sept. 1969). (In Russian).

Angular distributions and differential functions of excitation of the reactions ^{16}O(d,α)^{14}N as well as the total cross section of the reaction ^{16}O(d,γ)^{18}F in the deuteron energy region from 7 up to 12.5 MeV, and the total cross section of the reaction ^{14}N(α,γ)^{18}F at the α particle energy from 13 up to 18.5 MeV, are measured. The contribution of the mechanism of production of compound ^{18}F nucleus in the reaction ^{16}O(d,α)^{14}N is discussed. (auth)

8847 REACTION LIST FOR CHARGED-PARTICLE-INDUCED NUCLEAR REACTIONS. PART A. Z = 3 TO Z = 27 (Li TO Co). McGowan, F. K.; Milner, W. T.; Kim, H. J.; Hyatt, Wanda (Oak Ridge National Lab., Tenn.). Nucl. Data, Sect. A, 6: 353-644 (Oct. 1969).

This reaction list for charged-particle-induced nuclear reactions was prepared from the journal literature for the period from 1948 through April 1969. Each published experimental paper is listed under the target nucleus in the nuclear reaction with a brief statement of the type of data in the paper. The nuclear reaction is denoted by A(a,b)B, where $M_1 \geq$ (one-nucleon mass). There is no restriction on energy. Nuclear reactions involving mesons in the outgoing channel are not included. (auth)

8848 COMPARISON OF REACTION THEORIES FOR MULTILEVEL INTERFERENCE: THE ^{14}C + p REACTIONS. Tindle, C. T.; Vogt, E. (Univ. of British Columbia, Vancouver). Can. J. Phys.; 47: 2763-77(15 Dec 1969).

A comparison is made between the R-matrix and S-matrix theories of low-energy compound nucleus resonances for the particular case of two-level interference. The (p,γ) and (p,n) cross sections of ^{14}C for proton energies between 0.7 and 1.5 MeV are analyzed using both theories. The ^{15}N compound nucleus in this region exhibits strong two-level interference. The two theories provide equally good fits to the data, but the parameters describing the compound-nucleus levels are quite different. A general analytic method of relating the two sets of parameters is derived and shown to give good agreement with the results obtained by curve-fitting procedures. Remarks are made concerning the general behavior of the parameters under strong interference conditions and also on the inclusion of many channels into the analysis. (auth) (CANADA)

8849 OCTUPOLE TRANSITIONS IN ^{19}F AND OTHER S-D SHELL NUCLEI. Cusson, R. Y. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys.; 47: 2835-47(15 Dec 1969). (AECL-3481).

The deformed Nilsson model is first applied to the study of the E3 transition from the 1.347-MeV state ($J^{\pi} = \frac{5}{2}^{-}$) in ^{19}F to the ground state ($J^{\pi} = \frac{1}{2}^{+}$). The value 0.56 W.u. is obtained while the experimental one is 7.6 ± 1.3 W.u. A deformed schematic RPA calculation is then performed to describe a $Q_{3,0}$ octupole oscillation. An enhanced value of 2 W.u. is obtained without changing excessively the Nilsson configuration of the excited band head. Octupole sum rules are derived and evaluated for ^{16}O, ^{19}F, and ^{20}Ne. A study is made of the interplay between permanent quadrupole deformations and octupole vibrations. (auth) (CANADA)

8850 ^{12}C(n,α)^{9}Be REACTION AT 14.1 MeV. Hsu, Yuin-chi; Huang, Chia-yi; Lin, Song-yung; Hsu, Yi-chuann; Chou, Muh-chuen (National Taiwan Univ., Taipei). Chin. J. Phys. (Taiwan), 7: 1-6(Apr. 1969).

The energy spectrum and angular distribution of α-particles from the ^{12}C(n,α)^{9}Be reaction at 14.1 MeV were studied by using a cloud chamber. The group of α-particles leading to the ground state of ^{9}Be is clearly resolved; the groups to the levels at 1.75, 2.43 and 3.04 MeV are visible as well. The angular distribution of the emitted α-particles leading to the ground state of ^{9}Be indicates the presence of the direct interaction processes, and especially the observed strong peak in the backward angles suggests that the heavy-particle stripping process plays an important role in the ^{12}C(n,α_0)^{9}Be reaction. The observed angular distribution was compared with the heavy-particle stripping and knock-on processes using plane wave theory. (auth)

8851 ON POSSIBLE NON-AXIAL STRUCTURES IN ^{24}Mg AND ^{16}O. Abgrall, Y.; Baron, G.; Caurier, E.; Monsonego, G. (Centre de Recherches Nucleaires, Strasbourg). Phys. Lett., 30B: 376-8(Nov. 10, 1969).

The low-lying spectra of ^{24}Mg and ^{16}O are compared to the rotational bands obtained by projection from a single improved Hartree–Fock state exhibiting a triaxial equilibrium deformation. (auth)

8852 ELECTRON SCATTERING FORM FACTOR OF ^{9}Be. Bernheim, M.; Riskalla, R.; Stovall, T.; Vinciguerra, D. (Ecole Normale Superieure, Orsay, France). Phys. Lett., 30B: 412-13 (Nov. 10, 1969).

The cross sections for electron scattering from ^{9}Be are measured at E_e = 300, 600 and 700 MeV. The results are compared with theoretical predictions. (auth)

8853 OPTICAL MODEL APPLIED IN THE LOW ENERGY REGION OF LIGHT NUCLEI. Habanec, J. Phys. Lett., 30B: 402-3(Nov. 10, 1969).

The optical model is used for proton low energies and light nuclei in such a way that the optical model parameters are determined from the energies of single-particle resonances and other resonances are added. An agreement with experimental results was obtained for oxygen and carbon. (auth)

8854 OBSERVATION OF ALPHA-PARTICLE CORE-EXCITED THRESHOLD STATES IN ^{15}O. Weller, H. R. (Univ. of Florida, Gainesville). Phys. Lett., 30B: 409-11(Nov. 10, 1969).

The level scheme observed in ^{15}O via the ^{12}C(^{3}He,α_0)^{11}C reaction can be described with the α-particle core-excited threshold state model. The comparison of known angular momentum information with that predicted by the model indicates that the first two levels comprise a well separated doublet whereas higher levels are weakly split triplets. The level at 16.1 MeV has been observed to be a triplet. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 89

Refer also to abstracts 7642, 8557, 8831, 8832, 8839, 8844, 8845, 8847, 8849, 8851, and 8938.

8855 (AAEC/E-200) COMPILATION OF keV NEUTRON CAPTURE GAMMA RAYS IN THE MASS RANGE A = 40-70. Allen, B. J.; Bird, J. R.; Kenny, M. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct. 1969. 63p. Dep. CFSTI (U. S. Sales Only).

The keV neutron capture gamma ray spectra were measured for eleven elements in the mass range A = 40 to 70 using lithium germanium detectors. Averaged or resolved resonance spectra were

obtained for neutrons in the energy range 5 to 100 keV, produced by a pulsed Van de Graaff accelerator. A compilation of the results for each element is given together with thermal capture and (d,p) data. Gamma ray spectra are presented and major features of thermal capture and keV results are shown in decay schemes. (auth) (Australia)

8856 (AAEC/TM-512) MEASUREMENT OF THERMAL NEUTRON CAPTURE GAMMA RAYS IN IRON, COBALT, AND SCANDIUM. Raju, B. B. V.; Taylor, R. B.; Bird, J. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). July 1969. 18p. Dep. CFSTI (U. S. Sales Only).

A facility for the measurement of thermal neutron capture gamma rays is described and results are given for capture in ^{56}Fe, ^{59}Co, and ^{45}Sc. Measurements have been made of gamma rays which are in coincidence with the 147-keV transition in ^{46}Sc. The results indicate a preference for M1 transitions between negative parity states in ^{46}Sc. (auth) (Australia)

8857 (ANL-7564) FAST NEUTRONS INCIDENT ON VANADIUM. Smith, Alan B.; Whalen, James F.; Takeuchi, Kenji (Argonne National Lab., Ill.). May 1969. Contract W-31-109-eng-38. 68p. Dep. CFSTI.

Total neutron cross sections and elastic and inelastic neutron scattering cross sections are experimentally studied. Total neutron cross sections are determined with good resolution (≳1 keV) from 0.1 to 1.45 MeV. Differential elastic and inelastic scattering angular distributions are measured at incident neutron energy intervals of ≲10 keV from 0.3 to 1.5 MeV with incident neutron resolutions of ~20 keV. The inelastic excitation of states at 330 ± 10 keV and 926 ± 10 keV is observed. The experimental results are interpreted in terms of the optical model and statistical concepts, inclusive of resonance width fluctuations and correlations. The observed intermediate structure is discussed in the context of strongly overlapping resonances and distributions in resonance widths and spacings and in terms of an intermediate optical model. Comparison is made with previously reported experimental values and with the pertinent contents of the evaluated data file, ENDF-B. Numerical tabulations of the experimental results are provided. (auth)

8858 (CONF-691019-1) DIRECTIONAL ANISOTROPY OF NEUTRON-CAPTURE GAMMA RAYS FROM ALIGNED NUCLEI. Postma, H. (Leiden Rijksuniversiteit (Netherlands). Kamerlingh Onnes Laboratorium). [1969]. 15p. Dep. CFSTI (U. S. Sales Only).

From Meeting on Nuclear Physics Division, American Physical Society, Boulder, Colo.

Methods for the determination of nuclear spins in neutron-capture gamma spectroscopy are discussed. A technique using the directional anisotropy of neutron-capture γ rays from aligned nuclei is described in detail. Some results for neutron capture by aligned ^{149}Sm and ^{59}Co at 0.05 eV are presented. (J.W.R.)

8859 (ORNL-4455) TABULATED CROSS SECTIONS FOR HYDROGEN AND HELIUM PARTICLES PRODUCED BY 62-MeV AND 29-MeV PROTONS ON ^{27}Al. Bertrand, F. E.; Peelle, R. W. (Oak Ridge National Lab., Tenn.). Nov 1969. Contract W-7405-eng-26. 61p. Dep. CFSTI.

Tabulated differential cross sections are presented for the production of proton, deuteron, triton, helium-3, and alpha particles from ^{27}Al bombarded by 62- and 29-MeV protons. At 62 MeV, continuum cross sections are listed at 18 angles from 12 deg through 160 deg, while at 29 MeV data are given at only three angles. The low-energy cutoffs on the spectra range from 3 to 6 MeV. Angular distributions are given for excitation by 62-MeV protons of states at 0, 2.2, 2.7, and 3.0 MeV in ^{27}Al, and at 0, 1.06, 2.07, and 4.7 MeV in ^{26}Al. (auth)

8860 (RLO-1388-106) ELASTIC SCATTERING OF ALPHA PARTICLES BY INTERMEDIATE MASS NUCLEI. Fernandez, B.; Blair, J. S. (Washington Univ., Seattle. Dept. of Physics). [1969]. 52p. Dep. CFSTI.

Angular distributions of 42-MeV α particles, elastically scattered from ^{40,42,44,48}Ca, ^{46,48,50}Ti, ^{52}Cr, ^{54,56}Fe, ^{58,60,62}Ni were measured in the forward region with an absolute accuracy of ±0.1°; in particular, the locations of the minima near 35° (center of mass system) were determined to within ±0.1°. The theoretical analysis was done in three ways using: (a) the Fraunhofer model, (b) a direct parametrization of the scattering amplitude in terms of 3 parameters, and (c) a standard 4-parameter optical model. Strong absorption radii were deduced from the critical angular momenta extracted from the scattering amplitudes. In addition attempts have been made to determine, for the optical model analysis; other sorts of strong absorption radii which are more characteristic of the scattering than the usual midpoint radius of the potential. The analyses indicate that the rate of increase of almost all such strong absorption radii is smaller within the Ca isotopes and within the Ti isotopes than within the Fe and Ni isotopes, the radius of ^{48}Ca being anomalously small in all but one type of analysis. (auth)

8861 (UCRL-Trans-10397) VARIATION IN THE TOTAL RADIATIVE WIDTH Γ_γ AS A FUNCTION OF THE MASS NUMBER A AND VALUE OF THE SPIN J = ±½. Julien, J.; Alves, R.; de Barros, S.; Huynh, V. D.; Morgenstern, J.; Samour, C. Translated by W. Robinson for Univ. of California, Lawrence Radiation Lab., Livermore, from Nucl. Phys., A132: 129-60(1969). 58p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 37160.

8862 NUCLEAR SURFACE AND INELASTIC PROTON SCATTERING. Gruhn, C. R.; Preedom, B. M.; Thompson, K. (Michigan State Univ., East Lansing). Phys. Rev. Lett., 23: 1175-8 (Nov. 17, 1969).

Comparisons of the electromagnetic and proton inelastic-scattering reduced transition probabilities for the even nickel isotopes are made. It is found that the values obtained for high multipole transitions in the inelastic scattering are extremely sensitive to the nuclear density distribution. This sensitivity is investigated for various phenomenological models of the nuclear density distribution. (auth)

8863 ALPHA-CLUSTER PLUS ^{16}O-CORE MODEL FOR ^{20}Ne AND NEIGHBORING NUCLEI. Hiura, Jun; Abe, Yasuhisa; Saito, Sakae; Endo, Osamu (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto), 42: 555-80(Sept. 1969).

A possibility of α-cluster structure in nuclei around ^{20}Ne is examined in terms of a model based on the assumption of weak coupling between an α cluster and an ^{16}O core. The model treats dynamically the coupling of α-^{16}O relative motion with a particle (p)- and a hole (h)-motion in an average nuclear field of ^{16}O. The $K^\pi = 0^+$ rotational band of ^{20}Ne (α + ^{16}O) is plausibly explained with an effective α-^{16}O potential having repulsive-core and state-dependent attractive well. The low-lying anomalous-parity levels of ^{19}F (α + ^{16}O + h) and the ground rotational band of ^{21}Ne (α + ^{16}O + p) are reasonably understood in terms of an effective nucleon-α potential with the essential features of the potential in free space. The hole and particle are treated in the weak- and strong-coupling schemes, respectively. The $K^\pi = 2^-$ rotational band of ^{20}Ne* (α + ^{16}O + p + h) is well interpreted in the strong-coupling scheme for the p-h pair. In conclusion, certain successes of the model seem to suggest an importance of α-like four-body correlation or molecular aspect in light nuclei. (auth)

8864 PRECISION MEASUREMENTS OF GAMMA-RAY INTENSITIES AND ENERGIES IN THE DECAY OF ^{125}g,^{154}Eu^{56}, ^{110m}Co, Ag, AND ^{125}Sb. Aubin, G.; Barrette, J.; Barrette, M.; Monaro, S. (Univ., Montreal). Nucl. Instrum. Methods; 76: 93-9(1969).

With the aid of a computerized program the relative intensities of the prominent transitions present in the decay of ^{152}g,^{154}Eu, ^{56}Co, ^{110m}Ag and ^{125}Sb were calculated with very high precision. The energy values of the same transitions in the ^{152}g,^{154}Eu, ^{110m}Ag, and ^{125}Sb decays were also determined, very precisely, so that each of these sources could be employed both for energy calibration measurements and for linearity calibration of multi-channel analyzers. The measurements were performed with two Ge(Li) coaxial detectors with active volume of 5.3 cm^3 and 30 cm^3, respectively. It is shown that with the aid of these radioactive sources, one can construct a very precise efficiency curve for any other Ge(Li) detector from 100 keV to 3500 keV and reproduce to within 2 to 3% the measured gamma ray relative intensities in ^{22}Na, ^{207}Bi, ^{133}Ba, and ThC″. For these latter measurements a third Ge(Li) coaxial detector, with active volume of 32 cm^3, was employed. (auth)

8865 THEORY OF EXCITED STATES OF DEFORMED ODD NUCLEI. Isakov, B.; Sharipov, Sh. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 38-42(1969). (In(In Russian).

Theoretical values of the spins and energies of excited states of the ^{155}Gd nuclei are tabulated. Results of calculations show that the change in shape of the nucleus on excitation has an effect on excited states of odd nuclei. (tr-auth)

8866 ON MECHANISM OF THE REACTION ^{52}Cr(p,γ)^{53}Mn. Popov, A. I.; Abuzeid, M. A.; Mansur, N. A.; Saad, H. R.; Storizhko (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 10: 472-5(Sep 1969). (In Russian).

The problem is considered of applying the statistical theory to the description of angular correlations in reactions of radiative capture. Angular correlations in ^{52}Cr(p,γγ)^{53}Mn at $E_p < 2.5$ MeV

were measured. The results are in agreement with calculations of the statistical model. (auth)

8867 ELASTIC AND INELASTIC 13.6 MeV DEUTERON SCATTERING ON Ti ISOTOPES. Vereshchagin, A. N.; Korostova, I. N.; Chernov, I. P.; Shilyaev, B. A. (Tomsk Polytechnical Inst., USSR). Yadern. Fiz.; 10: 476-80(Sep 1969). (In Russian).

Differential cross sections of elastic deuteron scattering on the ^{46,47,48,49,50}Ti isotopes and inelastic scattering cross sections corresponding to the excitation of the lower 2^+ levels of ^{46}Ti and ^{48}Ti nuclei, are measured. The measured elastic scattering cross sections are analyzed on the basis of the optical model of the nucleus with the six-parameter potential. The theory is in good agreement with the experiment. The scattering on the ^{48}Ti nucleus was calculated by the complex angular momentum method. There is a satisfactory agreement in the region of <60° angles. The parameters obtained from the analysis of experimental data reproduce reasonably the measured cross section of inelastic scattering. (auth)

8868 ABOUT THE THERMODYNAMICAL DESCRIPTION OF ENERGY SPECTRA IN ATOMIC NUCLEI. Sokolov, Yu. V.; Stavinskii, V. S.; Usachev, L. N. Yadern. Fiz.; 10: 537-41 (Sep 1969). (In Russian).

The statistical sum and some thermodynamical functions are calculated for the nuclei ^{41}Ca, ^{51}Cr, ^{55,58}Fe, ^{59,61}Ni on the basis of the available spectroscopic data. Influence of the spectrum cut-off, missing of levels, and the level degeneration degree is estimated. (auth)

8869 THE STRUCTURE OF THE sd SHELL NUCLEI. IV. ^{20}Ne, ^{21}Ne, ^{22}Ne, ^{22}Na, AND ^{24}Mg. Akiyama, Y. (Univ. of Michigan, Ann Arbor); Arima, A.; Sebe, T. Nucl. Phys.; A138: 273-304(1969).

The shell model with the phenomenological effective interaction is applied to study level structures of ^{20}Ne, ^{21}Ne, ^{22}Ne, ^{22}Na, and ^{24}Mg. The full basis in the sd shell is taken in ^{20}Ne to diagonalize the energy matrices. This example confirms that SU_3 symmetry and the supermultiplet provide a very good way of truncation. This truncation is used to calculate level schemes of many nuclei beyond ^{20}Ne. Even though deviations of the effective interaction from the pure Q-Q interaction and the spin-orbit interaction break the SU_3 symmetry and the supermultiplet, the main components of calculated wave functions in low-lying energies can be very well labelled by these two symmetries. Generally, good agreement with observations is found. Particularly, the lowest rotational bands are nicely explained. Exceptions are the level structure of ^{22}Na and $\frac{1}{2}^+$ in ^{19}O and ^{21}Ne, which are too low in the calculation, and the K = 2 bands in ^{22}Ne and ^{24}Mg, which are again too low in the calculation. (auth)

8870 MECHANISM OF THE ^{31}P(p,γ)^{32}S REACTION IN THE GIANT DIPOLE RESONANCE REGION. Mason, W. M. (Nuclear Physics Lab., Oxford); Tanner, N. W.; Kernel, G. Nucl. Phys.; A138: 253-72(1969).

The radiative capture of protons by ^{31}P was studied in the energy range E_p = 9.5 to 11.5 MeV and the gamma rays to the ground and first excited states of ^{32}S were analyzed. Excitation functions and angular distributions were measured in energy steps of 20 keV. It was found that the angular distributions are almost invariant with energy and are slightly forward peaked indicating an E2 intensity of order one per cent. From the Legendre polynomial coefficient A_3/A_2 the channel spin s = 0 and s = 1 fractions of the cross section were separated for ground state gamma rays; it is observed that s = 0 accounts for ≈75% of the γ_0 integrated strength. There are large variations in gamma-ray yield as a function of energy and an analysis in terms of statistical fluctuation theory shows that ≈90% of the cross section is due to a "direct interaction" mechanism. A large correlation between the γ_0 and γ_1 yields is observed. (auth)

8871 CROSS SECTIONS OF SOME REACTIONS OF Al, S, Mn, Fe, Ni, In, AND I WITH 14.8 MeV NEUTRONS. Barrall, R. C.; Silbergeld, M. (Stanford Univ., Calif.). Nucl. Phys.; A138: 387-91(1969).

The cross sections for a number of reactions commonly used to measure 14-MeV neutron flux densities were determined using samples which were irradiated simultaneously: ^{27}Al(n,α)^{24}Na, 116 ± 8 mb; ^{32}S(n,p)^{32}P, 184 ± 15 mb; ^{55}Mn(n,2n)^{54}Mn, 75 ± 6 mb; ^{54}Fe(n,p)^{54}Mn, 300 ± 20 mb; ^{56}Fe(n,p)^{56}Mn, 109 ± 9 mb; ^{58}Ni(n,p)^{58}Co, 318 ± 25 mb; ^{58}Ni(n,pn + np + d)^{57}Co, 75 ± 6 mb; ^{58}Ni(n,2n)^{57}Ni, 36 ± 3 mb; ^{115}In(n,n′)^{115m}In, 69 ± 5 mb; ^{115}In(n,2n)^{114m}In, 1390 ± 110 mb; and ^{127}I(n,2n)^{126}I, 1660 ± 140 mb. The indicated errors are estimated two standard deviation limits, whereas the relative cross-section values are thought to be accurate to about 3%, and therefore of use for interrelating fast neutron cross sections measured relative to various of these monitor reactions. (auth)

8872 GAMMA-RAY SPECTRA FROM THE RADIATIVE CAPTURE OF 14.1 MeV NEUTRONS IN Mg, Si, P, AND Ca. Cvelbar, F.; Hudoklin, A.; Potokar, M. (Univ. of Ljubljana, Yugoslavia). Nucl. Phys.; A138: 412-16(1969).

Gamma-ray spectra from the radiative capture of 14.1-MeV neutrons in natural Mg, Si, P, and Ca measured with a scintillation telescope pair spectrometer are presented. Because of the spherical geometry of the experiment, spectra are integrated over a solid angle of 4π. The energy spread of the initial neutrons is 1.35 MeV. The excitation energy of residual nuclei ranges from zero to the neutron binding energy. The integrated cross sections for Mg, Si, P, and Ca are 300 ± 45 μb, 470 ± 75 μb, 360 ± 65 μb, and 520 ± 80 μb respectively. (auth)

8873 HALF-LIFE ALTERATION OF beta--DECAYING ANIONS AND CATIONS. THE HALF-LIFE OF ^{24}Na. Kemeny, P. (Inst. for Atomic Physics, Bucharest). Radiochem. Radioanal. Lett., 2: 119-24(Nov. 20, 1969).

It was observed that the half-life of ^{24}Na was /0.52 ± 0.20/% higher in solid NaCl than in its aqueous solution. From these measurements and from earlier ones on ^{131}I the following was seen to hold: Anions increase and cations decrease their β^- decay probabilities in crystalline form, in comparison with their aqueous solutions. This fact is discussed qualitatively, in terms of the corrections of β-decay probability. (auth)

8874 ELASTIC AND INELASTIC SCATTERING OF 6-MeV PROTONS ON Ni ISOTOPES. Antropov, A. E.; Bochin, V. P.; Zarubin, P. P.; Orlov, B. N.; Plavko, A. V.; Sorokin, A. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1741-6(1968). (In Russian).

Cross sections of elastic and inelastic scattering of 6.05-MeV protons on ^{58,60,61,62,64}Ni isotopes were calculated by means of an optical model. The real part of the optical potential was considered in the Saxon–Woods shape and the virtual part in the Gauss shape. Graphical angular distributions of the elastic and inelastic proton scattering are given. The cross sections for the first levels of ^{58}Ni and ^{60}Ni are in agreement with published data. The theoretical curve obtained for the first excitation level of ^{64}Ni did not agree with experiment at angles higher than 110°, but described correctly excitations at small angles with nuclear deformation parameter ^{62}Niβ_2 = 0.2. The absolute cross sections for ^{61}Ni excitation levels 0.908 and 1.019 MeV at 40 to 110° angle are in agreement with cross sections of the collective state of the 2^+ type. (R.V.J.)

8875 STUDY OF (p,d) REACTIONS ON ^{57}Fe, ^{61}Ni, ^{91}Zr WITH A PROTON-POLARIZED BEAM. Escudie, J. L.; Faivre, J. C.; Gosset, J.; Kamitsubo, H.; Lombard, R. M.; Mayer, B. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Rev. Lett., 23: 1251-2(Nov. 24, 1969).

Differential cross sections and asymmetries were measured for the (p,d) reactions on ^{57}Fe at 17.3 MeV, ^{61}Ni at 16.6 MeV, and ^{91}Zr at 24.5 MeV, from 15 to 150°. With optical parameters fitting experimental cross sections and polarizations for both ingoing protons and outgoing deuterons, the distorted-wave Born approximation gives a good account of the measurements. (auth)

8876 EXCITATION FUNCTIONS FOR THE ^{24}Mg(d,α)^{22}Na, ^{26}Mg(d,α)^{24}Na, AND ^{27}Al(d,αp)^{24}Na REACTIONS. Roehm, H. F.; Verwey, C. L.; Steyn, J.; Rautenbach, W. L. (National Physical Research Lab., Pretoria. National Chemical Research Lab., Pretoria). J. Inorg. Nucl. Chem., 31: 3345-56(Nov. 1969).

Excitation functions were determined by the "stacked-foil" technique for the ^{24}Mg(d,α)^{22}Na and ^{26}Mg(d,α)^{24}Na reactions from 0 to 10 MeV, and the ^{27}Al(d,αp)^{24}Na reaction from 0 to 16 MeV. The maximum measured cross-sections for the production of ^{22}Na and ^{24}Na from magnesium were 185 mbarn (8.6 MeV) and 118 mbarn (8.6 MeV) respectively. At 16.0 MeV the absolute cross-section for the production of ^{24}Na from aluminum was 24.0 mbarn. Thick-target yields were calculated as a function of energy (0 to 16 MeV) for the production of ^{22}Na and ^{24}Na from natural magnesium, and ^{24}Na from aluminum. The calculated production rates of ^{22}Na and ^{24}Na, by 16 MeV deuterons on natural magnesium, are 2.93 μCi/μA-hr and 578.34 μCi/μA-hr, respectively, while for production of ^{24}Na from aluminum a value of 170.562 μCi/μA-hr was obtained. (auth) (UK)

8877 ZERO-PHONON GAMMA-RAY TRANSITION IN ^{60}Ni. Van Hise, J. R.; Camp, D. C. (Univ. of California, Livermore). Phys. Rev. Lett., 23: 1248-50(Nov. 24, 1969).

Using a Compton-suppression spectrometer with a central Ge(Li) detector, a 346.95-keV gamma-ray transition between the 4_1^+ and 2_1^+ states in ^{60}Ni was observed. According to the simple

vibration model, this so-called zero-phonon transition is strictly forbidden. A lower limit of 0.174 is placed on the ratio of the observed to the single-particle rates. (auth)

8878 CALCULATION OF THE COULOMB ENERGY SHIFT BETWEEN ^{41}Sc AND ^{41}Ca. Auerbach, E. H.; Kahana, S.; Weneser, J. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Lett., 23: 1253-6(Nov. 24, 1969).

A straightforward, purely single-particle analysis of the Coulomb energy shift in ^{41}Sc, ^{41}Ca leads to an abnormally small radius for the $f_{\frac{7}{2}}$ valence neutron. A correlational correction that may help to increase this radius is presented. The calculation of this correction is stated in as general a fashion as is possible, and an estimate is made which leans heavily on a parametrization of the proton and neutron densities. (auth)

8879 GAMMA RAYS FROM THE 3702 keV LEVEL IN ^{25}Al. Anyas-Weiss, N.; Litherland, A. E. (Univ. of Toronto). Can. J. Phys.; 47: 2609-19(1 Dec 1969).

The decay modes of the $\frac{7}{2}^-$, 3702-keV level in ^{25}Al were studied at the E_p = 1490-keV resonance in the ^{24}Mg(p,γ)^{25}Al reaction. The decay gamma rays were observed using a 25 cm^3 Ge(Li) detector. A previously unreported 2% transition from the resonance to the level at 2723 keV was observed. The angular distribution of this gamma ray admits only a spin of $\frac{7}{2}$ for the 2723-keV level. The lifetime of the 2723-keV level was measured with the Doppler shift attenuation method (DSAM) at the 1660-keV resonance and was found to be $\tau(2723) = 450^{+100}_{-80}$ fs. The lifetime of the $\frac{5}{2}^+$, 1790-keV level was measured using the DSAM and was found to be $\tau(1790) = 550^{+100}_{-70}$ fs. From Doppler shift measurements a lower limit for the lifetime of the $\frac{3}{2}^+$, 945-keV level of $\tau(945) \geq 6$ ps was obtained. From angular distribution measurements at the E_p = 1490-keV resonance, the following multipole mixing ratios were measured: $\delta(R \rightarrow 0) = 0.00 \pm 0.02$; $\delta(R \rightarrow 1790) = -0.02 \pm 0.02$; $\delta(R \rightarrow 2723) = 0.15 \pm 0.30$; $\delta(1790 \rightarrow 0) = -0.78^{+0.35}_{-0.25}$; $\delta(1790 \rightarrow 945) = -0.15 \pm 0.05$; $\delta(945 \rightarrow 0) = 0.35 \pm 0.10$ or 1.7 ± 0.2; $\delta(945 \rightarrow 451) = -0.15 \pm 0.05$ or 2.6 ± 0.4. Comparisons with data in the mirror nucleus ^{25}Mg were made. (auth) (CANADA)

8880 IS THE ^{56}Ni NUCLEUS DOUBLY MAGIC. Gambhir, Y. K.; Gmitrova, E.; Gmitro, M. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Lett., 30B: 382-5(Nov. 10, 1969).

Assumed closure of the $f_{\frac{7}{2}}$ proton and neutron sub-shells in nickel isotopes is investigated in a simple model based on the number-projected BCS wave functions with several realistic nucleon-nucleon potentials. (auth)

8881 DETERMINATION OF THE MEAN LIVES OF SOME EXCITED STATES OF ^{33}S THROUGH DOPPLER-SHIFT ATTENUATION MEASUREMENT. Brandolini, F.; Benuzzi-Martins, J.; Ricci, R. A.; Signorini, C. (Univ., Padua. Istituto Nazionale di Fisica Nucleare, Padua). Nuovo Cim., Lett., 2: 600-4(Oct. 21, 1969).

The mean lifetimes of several states in ^{33}S excited through the ^{30}Si(α,n) reaction were determined through Doppler-shift attenuation measurements. The experimental γ-width, measured using a Ge(Li) detector, were compared with M1 and E2 Weisskopf estimates. The observed enhancement in the E2 transition rates is evidence for collective behavior. (J.W.R.)

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Refer also to abstracts 7642, 7643, 7645, 8557, 8626, 8831, 8832, 8839, 8844, 8845, 8858, 8861, 8864, and 8875.

8882 (ANL-7590) MATDIAG: A PROGRAM FOR COMPUTING MULTILEVEL S-MATRIX RESONANCE PARAMETERS. Moldauer, Peter A.; Hwang, Richard N.; Garbow, Burton S. (Argonne National Lab., Ill.). Jul 1969. Contract W-31-109-eng-38. 28p. Dep. CFSTI.

The program MATDIAG computes cross-section resonance parameters from Wigner's R-matrix. The input R-matrix parameters may be specified individually, or they may be generated statistically. The generated resonance parameters are analyzed statistically and may be used for the calculation of Doppler-broadened multilevel cross sections in other programs. (auth)

8883 (BMwF-FBK-69-37) NUCLEAR RESEARCH. Annual Report, 1968. (Technische Hochschule, Munich (West Germany). Teilinstitut Maier-Leibnitz im Physikdepartment). Nov 1969. 246p. (In German). Dep. CFSTI (U. S. Sales Only).

From nuclear physics the following results are given: Measurements and calculations of (n,e$^-$), (n,γ) and (n,n'γ) spectra, of cross-sections for (n,2n) reactions, of coherent scattering length and of free cross sections for slow neutrons and of half-lives of excited levels of Ag and U. It is reported about the influence of radiation damage after low temperature irradiation on electrical, magnetic and lattice properties of metals as well as about scattering experiments with slow neutrons and x rays on liquids and poly-crystals. New apparative developments have been a time-of-flight neutron spectrometer with high resolution, neutron guide tubes for polarized and very slow neutrons, a magnet spectrograph and a time-of-flight system for the tandem accelerator. (auth)

8884 (CONF-690301-, pp 622-32) AUTOMATIC ANALYSIS OF NEUTRON CROSS SECTION DATA USING INTERACTIVE GRAPHICS AS AN AID. Simpson, O. D. (Idaho Nuclear Corp., Idaho Falls); Marshall, N. H. (Phillips Petroleum Co., Idaho Falls, Idaho); Dunford, C. L. (Atomics International, Canoga Park, Calif.).

The increased volume of cross section data from nuclear experiments and the complexity of the experiments being carried out have caused serious problems in the reduction and interpretation of the data. To speed data analysis and assist in comprehension, an automatic Shape and Peak Fitting Program (SAP) has been developed for obtaining single level or multilevel resonance parameters. To make SAP most effective, methods of man-machine communication are being carried out. SAP is being combined with SCØRE (a graphics display program which was developed jointly by Atomics International and IBM) using an IBM 360-75 computer with a 2250 Model 1 graphics display system. The interactive display allows a rapid visual representation of the data analysis and assists in maintaining a continuity of thought. Analysis of cross section data using SAP are compared with the older conventional techniques for obtaining resonance parameters. Plans for extending SAP to do a simultaneous analysis of complete sets of total and partial cross sections are projected. (auth)

8885 (IAE-1819) CONCERNING THE NUMBER OF FISSION CHANNELS AND THE INTERPRETATION OF THE ENERGY-DEPENDENCE PROBABILITY OF THE (d, Pf) REACTION. Vorotnikov, P. Yu. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1969. 16p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Attention is directed toward errors in existing methods for determining the number of fission channels. It is shown in particular that the steps in the energy dependence of the fission probability of ^{239}Pu by deuterons and similar nuclei can be explained by the resonance maxima of the fission width related to the quasistationary states of the fissioning nuclei. The widths of the states are several hundred keV and the distance between them is about 0.7 MeV. These states, also evident in cross sections of the (d,p) reaction, are observed up to excitation energies exceeding the fission barrier by 1.5 MeV, and therefore cannot be explained as features of the form of the barrier. Certain properties of quasistationary states are discussed, and an assumption is made that they are related to the stable octupole deformation of the nucleus prior to fission. (auth)

8886 (JINR-P15-4738) SEARCH FOR LONG-LIVED SPONTANEOUSLY FISSIONING EMITTER IN THE SAMPLES WITH Bi, Pb, Hg, W. Cieslak, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1969. 12p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Tracks of nuclear fission fragments were observed in the glasses with Bi, Pb, Hg and W. For a few samples of lead glasses the measured spontaneous fission half-life was found to be 3×10^{20} years. Observed tracks cannot be explained either by spontaneous fission or by cosmic-ray induced fission of a uranium impurity. The presented data support the hypothesis of the existence of long-lived spontaneously fissioning nuclei. (auth)

8887 (LFEN-NI-38-a) ^{198}Au HALF LIFE. Costa Paiva, M. M.; Martinho, E. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1968. 15p. (In Portuguese). Dep. CFSTI (U. S. Sales Only).

The half-life of ^{198}Au was measured by the evolution of the counting rate corresponding to the photoelectric peak at 412 keV. The measurements were made in a single-channel γ spectrometer with NaI(Tl) crystal for a period of about 29 days. The result obtained was T = 2.696 ± 0.004 days. The weighed mean value was calculated from values determined in the present study and from values previously published by others. The value found was T = 2.6963 ± 0.0013 days. A table of the values of the $e^{-\lambda t}$ and $(1 - e^{-\lambda t})$ values used for the calculation of the weighted mean half-life of ^{198}Au is presented in the appendix. (tr-auth)

8888 (NP-18064) PION EFFECTS IN $^{127}I(\gamma,xn)$ REACTIONS OF HIGH MULTIPLICITY. Jonsson, G. G.; Lindgren, K. (Lund Univ. (Sweden). Dept. of Physics. Lund Inst. of Tech (Sweden). Dept. of Nuclear Physics). Oct. 1969. 14p. Dep. CFSTI (U. S. Sales Only).

The yields of the reactions $(\gamma,6n)$, $(\gamma,7n)$, $(\gamma,8n)$, and $(\gamma,9n)$ in ^{127}I were measured by activation analysis from their thresholds up to 900 MeV. The experimental results above the pion threshold were compared with theoretical calculations based upon a cascade-evaporation model. Good agreement was found. (auth) (Sweden)

8889 (ORNL-4460) TABULATED CROSS SECTIONS FOR HYDROGEN AND HELIUM PARTICLES PRODUCED BY 62- AND 29-MeV PROTONS ON ^{197}Au. Bertrand, F. E.; Peelle, R. W. (Oak Ridge National Lab., Tenn.). Dec 1969. Contract W-7405-eng-26. 43p. Dep. CFSTI.

Tabulated differential cross sections are presented for the production spectra of proton, deuteron, triton, helium-3 and alpha particles from ^{197}Au bombarded by approximately 62- and 29-MeV protons. Continuum cross sections are given at 6 angles from 15 through 125 degrees, over the energy region down to a low-energy cutoff of 3 to 13 MeV which depends on particle type. (auth)

8890 (RISO-M-966) CALCULATION OF THE RESONANCE INTEGRAL OF ^{232}Th AND SUMMARY OF EXPERIMENTAL RESULTS. Mikkelsen, Joern (Danish Atomic Energy Commission, Risoe. Research Establishment). Sept. 1969. 22p. Dep. CFSTI (U. S. Sales Only).

The resonance integral of ^{232}Th is calculated by means of the program RESAB. The applied resonance radiation widths are smaller than those generally used in calculations, but in close accordance with the most recent cross section measurements. The obtained resonance integral is in excellent agreement with the experimental results. (auth) (Denmark)

8891 (RLO-1388-107) SPONTANEOUS FISSION ISOMERS. Wolf, Kevin L. (Washington Univ., Seattle). 1969. 83p. Dep. CFSTI.

Thesis.

A search for spontaneous fission isomers was made, chiefly in the plutonium isotopes, by bombarding uranium targets with 21- to 42-MeV helium ions. A system that is capable of direct electronic measurement of fission half-lives as short as two nanoseconds was developed. Three plutonium isomers were identified. These isomers and their half-lives are $^{240m}Pu(t_{\frac{1}{2}} = 4.4 \pm 0.8$ nsec), $^{239m}Pu(t_{\frac{1}{2}} \geq 400$ nsec), and $^{237m}Pu(t_{\frac{1}{2}} = 120 \pm 30$ nsec). Absolute cross sections were determined for the production of each isomer. From the cross sections, an indirect method was used to determine the isomeric excitation energies relative to the ground states of these nuclei. These isomers were interpreted in terms of metastable states associated with double-humped fission barriers. The half-life and excitation energy results, along with the known ground-state spontaneous fission half-life and the height of the fission barrier, were used in calculations that give a consistent one-dimensional interpretation of the fission barrier for the even-even nucleus ^{240}Pu. (auth)

8892 (SGAE-G-14/1969) RESULTS ON RECENT WORK IN MASS SPECTROSCOPIC AND NUCLEAR PHYSICS RESEARCH AT THE REACTOR CENTRE SEIBERSDORF. Higatsberger, M. J. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). [1969]. 19p. (CONF-690926-2). Dep. CFSTI (U. S. Sales Only).

From Conference on Mass Spectrometry, Kyoto, Japan.

Results are summarized for recent work on neutron decay, pile neutron induced reaction cross sections, fission product migration in high temperature reactor fuels, and production of unconventional mass spectrometers for special use. (J.W.R.)

8893 (SGAE-PH-86/1969) A STUDY ON THE PROMPT GAMMA RAYS OF ^{252}Cf-FISSION. Rumpold, K.; Semturs, F.; Weinzierl, P. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf, Physik-Institut). [1969]. 13p. (CONF-690708-6). Dep. CFSTI (U. S. Sales Only).

From 2nd Conference on Physics and Chemistry of Fission, Vienna, Austria.

The prompt gamma ray spectra in the range between 50 and 550 keV were measured simultaneously at angles of 90 and 180° with respect to the fragment direction. Using fission fragment energy as an additional parameter, it was possible to find well-resolved gamma lines, and cases of Doppler-shifts were easily observed. The amount of shift was used to deduce fragment masses. The type of Doppler spectrum was used to classify gamma lifetimes according to three intervals: ($T < 10^{-12}$ sec, 10^{-12} sec $< T < 2 \times 10^{-9}$ sec, 2×10^{-9} sec $< T < 10^{-7}$ sec). The first limit is due to the fragment stopping time in the backing of the Cf-foil (10^{-12} sec). The fragment time of flight from source to detector determines the second interval to $10^{-12} < T < 2 \times 10^{-9}$ sec, while the last interval was limited by the electronic coincidence width to 10^{-7} sec. About half of the gamma lines were found to lie in the second interval and could be assigned to definite fragment masses. (auth)

8894 M1 ADMIXTURES IN TRANSITIONS FROM THE 3/sub gamma/$^+$ AND 4/sub gamma/$^+$ LEVELS IN ^{154}Gd. Hamilton, J. H.; Ramayya, A. V.; Whitlock, L. C. (Vanderbilt Univ., Nashville). Phys. Rev. Lett., 23: 1178-80(Nov. 17, 1969).

Gamma-gamma directional correlations were measured in ^{154}Gd with a Ge(Li) detector in one channel. The M1 admixtures in the 3_β^+-2^+, 3_β^+-4_γ^+, and 4_γ^+-4^+ transitions were measured to be <1, (3,0 ± 0,3), and (4,8 ± 0,8)%, respectively. The M3 admixture in the 2_β^+-4^+ and 2_γ^+-4^+ transitions is (0.1 ± 0.1)%. (auth)

8895 DENSITY FUNCTION FOR S NEUTRONS OF STABLE ISOTOPES OF TELLURIUM. Tellier, Henry; Alix, Michel; Dabbs, John (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. B, 269: 266-9(Aug. 4, 1969). (In French).

Measurements of the total cross section of tellurium isotopes were carried out by the time-of-flight method. The isotopic allocation and the analysis of resonances permit the density function of s neutrons to be obtained relative to each isotope as the parameter a (MeV^{-1}) for mass numbers included between 123 and 131. (tr-auth)

8896 DISTRIBUTION OF MASS IN SPONTANEOUS AND NEUTRON-INDUCED FISSION. von Gunten, H. R. (Univ., Bern). Actinides Rev.: 1: 275-98(Sept 1969).

The distribution of mass in low-energy-fission, i.e., spontaneous fission, thermal-neutron-induced fission, and fission with neutrons of energies up to 14 MeV, is discussed. Mass distributions measured by radiochemical and mass-spectrometric means are presented for fissionable nuclei ranging from ^{227}Ac to ^{252}Cf, including mass-yield curves for the thermal-neutron-induced fission of ^{227}Th and ^{249}Cf, which have not been published before. A comparison of all these mass distributions is made: some common features and regularities are treated, such as the dependence of the position of the maxima and widths of the mass distribution curve on the mass of the fissioning nucleus, and the change of mass distribution with increasing energy of the bombarding neutrons. Averaged "best" values for mass-yields in the spontaneous fission of ^{238}U and ^{252}Cf, in the reactor-neutron-induced fission of ^{237}Np and ^{241}Am, and in the 14 MeV-neutron-induced fission of ^{232}Th, ^{235}U and ^{238}U are proposed. These "best" values suggest a spontaneous fission half-life for ^{238}U of $(8,0 \pm 0,2) \cdot 10^{15}$ years. Furthermore an extensive review is given of the literature concerning mass-distributions in low-energy-fission. (auth)

8897 ON THE USE OF COMPUTER PROGRAMS IN THE ANALYSIS OF FAST NEUTRON CROSS SECTIONS BY THE ACTIVATION METHOD. Abels, C.; Bissem, H.; Bormann, M.; Lammers, B.; Magiera, E. (Univ., Hamburg). Nucl. Instrum. Methods: 76: 103-8(1969). (In German).

Special computer-programs are discussed which may be used in the analysis of measurements of fast neutron cross sections applying the activation method. For various shapes of the activated samples the average neutron energy and the average neutron flux density are calculated for the monoenergetic fast neutron sources usually used in experiments. Moreover, a method is described for deducing the absolute activities from the measured total decay curve which works sufficiently well also if several activities with different half-lives and intensities are present. All programs are written in ALGOL and are available on request. (auth)

8898 DOUBLE-FORBIDDEN β TRANSITIONS IN NUCLEI ^{129}I, ^{135}Cs, ^{137}Cs. Kopytin, I. V. (Voronezh State Univ., USSR). Yadern. Fiz.; 10: 519-22(Sep 1969). (In Russian).

Theoretical form factors are obtained and lg ft is calculated for β decay of nuclei ^{129}I, ^{135}Cs, and ^{137}Cs. The results of calculations are in satisfactory agreement with the experiments in particular, with those on the low-energy transitions in ^{129}I and ^{135}Cs. The nuclear matrix elements are obtained in framework of the theory of finite Fermi systems. (auth)

8899 COMPARISON OF THE $1/4^+(411)$ PROTON AND $1/2^-(521)$ NEUTRON IN ODD $^{170}_{69}Tm$, $^{172}_{69}Tm$, AND $^{170}_{71}Lu$. Treern, Zh.; Vankhorenbek, Dzh.; Valentin, Zh. (Inst. of Nuclear Physics, Orsay, France. Inst. for Nuclear Research, Grenoble, France). Izv. Akad. Nauk SSSR, Ser. Fiz., 33: 1252-5(Aug. 1969). (In Russian).

The energy level scheme for ^{170}Tm in which, due to the pairing of protons in $\frac{1}{2}^+$ (411) state with $\frac{1}{2}^-$ (521) neutrons, the ground state exhibited characteristics 1^- was suggested by R. K. Sheline et al. (Phys. Rev. 143, 857, 1966). The authors uncovered the 1^- state at excitation energy of 407 keV. An identical pairing was

anticipated for ^{170}Lu. Studies of the decay scheme of ^{170}Hf revealed corresponding states in ^{170}Lu at 244.9 keV. An antiparallel pairing $\Omega_p - \Omega = 0^-$ was observed in all three cases. An attempt was made to compare the behavior of such a doublet in ^{170}Tm, ^{172}Tm, and ^{176}Lu. The decay scheme of ^{176}Hf and the energy intervals between excited states of the above nuclei are included. (R.V.J.)

8900 NON-ROTATIONAL STATES OF DEFORMED NUCLEI WITH ODD NUMBER OF PROTONS AT $177 \geq A \geq 187$. Malov, L. A.; Solov'ev, V. G.; Fainer, U. M. (Joint Inst. for Nuclear Research, Dubna, USSR. Inst. of Physics, Riga). Izv. Akad. Nauk SSSR, Ser. Fiz., 33: 1244-51(Aug. 1969). (In Russian).

The energy and structure of the ground and excited states of odd-Z nuclei in the region $177 \geq A \geq 187$ were calculated using the Saxon–Woods single-particle energy and wave functions for A = 181. The energies of quadrupole and octupole phonons obtained previously were used in the computation. The calculations were confined to β-deformations equal to 0.20, 0.23, and 0.26 and characteristics are given for all states with energies up to 1 MeV and for some with energies up to 1.5 MeV. (R.V.J.)

8901 ANGULAR DISTRIBUTIONS OF FISSION FRAGMENTS IN REACTION ^{231}Pa(n,f). Vorotnikov, P. E.; Dubrovina, S. M.; Otroshchenko, G. A. Shigin, V. A. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 10: 488-90(Sep 1969). (In Russian).

Results of measurements of angular distributions of fragments in ^{231}Pa fission by neutrons near the fission threshold, are given. The measurements are performed in the neutron energy region 140 to 1300 keV at the angles 12, 30, 60, and 90°. Glasses were used to register fragments. With the change of the neutrons' energy, there are sharp changes of the fragment angular distributions which correlate with the irregularities in the cross section of the fission. (auth)

8902 ANGULAR ANISOTROPY AND ASYMMETRY OF FRAGMENT MASSES AT FISSION OF ^{235}U AND ^{238}U. Vorob'eva, V. G.; Gentosh, A. I.; Kuzminov, B. D.; Sergachev, A. I. Yadern. Fiz.; 10: 491-5(Sep 1969). (In Russian).

The results are presented of measurement of the angular anisotropy of fragments as a function of their masses in fission of ^{235}U and ^{238}U induced by neutrons of 3 and 1.6 MeV, respectively. It is noted that the angular anisotropy of the fragments with different masses does not vary, up to the experimental errors. (auth)

8903 SOME PROPERTIES OF EXCITED LEVELS IN ^{159}Tb, ^{161}Tb, AND ^{161}Dy. Begzhanov, R. B.; Sadykov, Kh. M. (Inst. of Nuclear Physics, Tashkent). Yadern. Fiz.; 10: 445-9(Sep 1969). (In Russian).

Lifetimes of the levels at 364 keV in ^{159}Tb, 417 keV in ^{161}Tb, and 25.75 and 132 keV in ^{161}Dy were measured with a special set-up using the methods of $\beta\gamma$, $\gamma\gamma$, and $\beta\gamma\gamma$ coincidences. (auth)

8904 GIANT RESONANCE IN THE REGION OF TRANSITION FROM SPHERICAL NUCLEI TO DEFORMED ONES. Vasil'ev, O. V.; Zalesnyi, G. N.; Semenko, S. F.; Semenov, V. A. (Saratov State Univ., USSR). Yadern. Fiz.; 10: 460-8(Sep 1969). (In Russian).

Cross sections of photoneutron reactions on nuclei in the region of transition between spherical and deformed nuclei (^{148}Nd, ^{150}Nd, ^{150}Sm, ^{152}Sm, ^{154}Sm) are measured. The results are compared with the predictions of the phenomenological model of the quadrupole-dipole interaction. (auth)

8905 LIFETIMES ASSOCIATED WITH LOW-ENERGY GAMMA TRANSITIONS IN ^{128}I AND ^{134}Cs. Korteling, R. G. (Simon Frazer Univ., Burnaby, B. C.); D'Auria, J. M.; Jones, C. H. W.; Isenhour, T. L. Nucl. Phys.; A138: 392-400(1969).

A study of the lifetimes and energies associated with low-energy gamma transitions from ^{127}I(n,γ)^{128}I and ^{133}Cs(n,γ)^{134}Cs reactions were studied using a high-resolution Ge(Li) X-ray spectrometer system. In the de-excitation of ^{128}I new transitions were observed at 147.01 and 156.08 keV in addition to those previously reported and a lifetime of 8 ns was confirmed for the line at 133.31 keV. In the case of ^{134}Cs decay, the line at 116 keV was resolved into a quartet of lines of energies 113.67, 116.26, 118.27, and 120.43 keV. Several delayed states were observed including half-lives of 15 and 55 ns associated with lines at 116.26 and 118.27 keV and a half-life of 38 ns connected with the 176.18-keV transition. (auth)

8906 ANALYSIS OF ELECTRON SCATTERING AND MUONIC X-RAYS FOR ^{208}Pb. Negele, J. W. (Cornell Univ.,) Ithaca, N. Y.). Nucl. Phys.; A138: 401-11(1969).

Recent electron scattering and muonic X-ray data are simultaneously analyzed using a three-parameter parabolic Fermi distribution, the same distribution with a realistic exponential tail and a theoretical distribution from density dependent Hartree–Fock theory. Inclusion of the known muonic X-ray corrections is shown to give a slightly inconsistent fit to the four lowest muon energy levels. χ-square contours for electron scattering and muonic X-rays are shown to overlap somewhat better for distributions with a wine-bottle shape, but a completely satisfactory simultaneous fit is not obtained. (auth)

8907 INTERNAL CONVERSION COEFFICIENTS IN ^{195}Pt. Fink, T.; Benczer-Koller, N. (Rutgers-The State Univ., New Brunswick, N. J.). Nucl. Phys.; A138: 337-46(1969).

The total and partial internal conversion coefficients of the 31-, 99- and 130-keV transitions in ^{195}Pt were measured with a magnetic solenoid electron spectrometer, scintillation, and Ge(Li) detectors. The spectrometer transmission and the efficiencies of the gamma-ray detectors were experimentally determined with calibrated reference sources. Corrections to the electron line intensities arising from scattering in the source backing and in the source itself were determined from the analysis of the continuous β-spectrum of ^{63}Ni sources of various thicknesses evaporated on backings of various thicknesses. The coefficients of the 99-keV transition $\alpha_K = 5.8 \pm 0.5$ and $\alpha = 6.9 \pm 0.5$ are in excellent agreement with the previous Moessbauer and gamma spectroscopy results of Harris et al. The partial conversion coefficient ratios of the 31- and 99-keV M1 transitions are about 10% larger than the theoretical calculations of Hager and Seltzer. (auth)

8908 POSITRON–GAMMA ANGULAR CORRELATION MEASUREMENTS ON THE DECAYS OF ^{84}Rb, ^{74}As, ^{124}I, AND ^{102}Rh. de Beer, A.; Stuivenberg, J. H.; Meindersma, B.; Blok, J. (Vrije Univ., Amsterdam). Nucl. Phys.; A138: 457-69 (1969).

Positron-gamma angular correlations were measured using a plastic scintillator to detect the positrons. The disturbance of the positron spectrum due to Compton scattering of the annihilation quanta in the plastic has been avoided by counting these quanta simultaneously in two large NaI(Tl) crystals. Measurements were performed on $2^- \rightarrow 2^+$ nonunique first order forbidden transitions from the ground states to the first excited states in: ^{84}Rb $\rightarrow$ ^{84}Kr, ^{74}As $\rightarrow$ ^{74}Ge and ^{124}I $\rightarrow$ ^{124}Te. The character of the transition ^{102}Rh $\rightarrow$ ^{102}Ru was unknown due to uncertainties in the ground state spin of ^{102}Rh. It turned out to be most probably a $1^- \rightarrow 2^+$ transition. (auth)

8909 DECAY CHARACTERISTICS OF LEVELS IN ^{151}Eu. Hoeglund, Ake (Univ. of Stockholm); Malmskog, Sven G. Nucl. Phys.; A138: 470-80(1969).

High-resolution gamma-ray spectra were recorded in the decay of ^{151}Gd. Fifteen transitions were observed, four of which have not been reported earlier. All transitions were fitted into a level scheme requiring two new levels. Spin and parity assignments were made giving at least three negative parity levels in ^{151}Eu. Using an electron-electron coincidence spectrometer some half-lives of excited levels in ^{151}Eu were measured. (auth)

8910 E2 AND M1 TRANSITION PROBABILITIES IN ODD-MASS Hg NUCLEI. Baecklin, A. (Uppsala Univ. Swedish Research Councils Lab., Studsvik, Sweden); Fogelberg, B.; Berg, V.; Malmskog, S. G. Nucl. Phys.; A138: 429-41(1969).

L- and M-subshell ratios were measured for the 39.45-keV transition in ^{193}Hg and the 37.13- and 16.2-keV transitions in ^{195}Hg yielding 0.38 ± 0.12, <0.02 and 0.08 ± 0.03% E2, respectively. The half-lives of the 39.49-keV level in ^{193}Hg, and the 53.34- and 37.13-keV levels in ^{195}Hg were measured with the delayed coincidence method yielding values of 0.63 ± 0.03, 0.72 ± 0.03 and <0.05 nsec respectively. A systematic compilation of reduced E2 and M1 transition probabilities in odd mass Pt, Hg and Pb nuclei is given and compared to theoretical predictions. (auth)

8911 DELAYED PROTONS AND GROSS STRUCTURE OF THE β DECAY. Karnaukhov, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 10: 450-9(Sep 1969). (In Russian).

The spectrum of delayed protons accompanying the decay of ^{111}Te is analyzed. The averaged spectrum is compared with the calculated one at various assumptions on the strength function $\langle\mu^2\rangle/D$, where $\langle\mu^2\rangle$ is the mean square matrix element of the allowed β decay and D is the mean distance between the levels of the daughter nucleus ^{111}Sb. The calculation is shown to contradict to the experiment if $\langle\mu^2\rangle$ is assumed to be independent on the excitation energy of the daughter nucleus. A satisfactory agreement with the experiment is obtained assuming the strength function to be constant. The agreement is improved by account of the possible existence of the giant resonance in the strength function of the

Gamow–Teller transition with the maximum near the isobar-analog state. An analysis of the "fine" structure of the proton spectrum shows that the number of levels participating in formation of the proton spectrum is about 1/6 of that calculated from the statistical formulas. The conclusions derived are directly related also to the interpretation of the data on delayed neutrons. (auth)

8912 NEW NEUTRON-DEFICIENT Ta ISOTOPES WITH MASS NUMBERS A = 167 TO 171. HALF-LIFE PERIODS OF DEFORMED NEUTRON-DEFICIENT NUCLEI IN THE RANGE FROM 150 < A < 190 WERE CLASSIFIED. Arl't, R.; Malek, Z.; Muziol, G.; Shtrusnyi, Kh. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 33: 1232-43(Aug. 1969). (In Russian).

The half-life for ^{172}Ta was verified, and tantalum isotopes with mass numbers A = 167 to 171 were found and their half-lives were determined. A search was also made for tantalum isotope with mass number A > 172. (R.V.J.)

8913 NEW NEUTRON-DEFICIENT ISOTOPES ^{169}Hf, ^{167}Hf, ^{166}Hf, AND ^{166}Lu. THE DECAY SCHEME OF ^{169}Hf ISOTOPE. Arl't, R.; Malek, Z.; Muziol, G.; Pfrepper, G.; Shtrusnyi, Kh. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 33: 1218-31(Aug. 1969). (In Russian).

The basic characteristics of short-lived neutron-deficient Hf isotopes were studied, and it was shown that the ^{169}Hf and ^{167}Hf isotopes were previously identified incorrectly. The half-life for ^{169}Hf was found to be 3.2 ± 0.1 min and for ^{167}Hf $T_{1/2}$ = 1.9 ± 0.2 min. (R.V.J.)

8914 NEUTRON RESONANCES OF ISOTOPES ^{130} ^{132}Ba. Vertebnyi, V. P.; Kalchenko, A. I.; Pasechnik, M. V.; Pisanko, Zh. I. (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 14: 227-30 (Feb. 1969). (In Russian).

Transmission of samples of natural barium and its isotopes ^{130,132}Ba were measured in the energy range of 3 to 1000 eV (resolution 0.05 μs/m) by the time-of-flight method. Steel containers with slit dimensions 28 × 2 × 8 mm were used for the measurements. ^{130}Ba levels with energies 46.6 ± 0.3 eV and 58.2 ± 0.2 eV are detected, their neutron widths equal to Γ_n = 27 ± 7 MeV and Γ_n = 144 ± 27 MeV, respectively. Probably, 137 ± 3 eV and 186 ± 4 eV levels also belong to ^{130}Ba. The levels of isotope ^{132}Ba are not found in the given range of energies. (auth)

8915 STUDY OF THE GIANT RESONANCE STRUCTURE OF THE ^{208}Pb NUCLEUS. Beil, Hans; Bergere, Roland; Carlos, Pierre; Veyssiere, Andre (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. B, 269: 216-19 (July 28, 1969). (In French).

A high-resolution study of the reaction ^{208}Pb(γ,n)^{207}Pb permits a detailed structure to be shown in the slope of the giant resonance in good agreement with theoretical predictions. (tr-auth)

8916 ^{91}Zr(p,p') REACTION AT 14.52 MeV. Awaya, Yohko; Matsuda, Kazuhisa; Nakanishi, Noriyoshi; Takeda, Shigeru; Wada, Takeshi (Inst. of Physical and Chemical Research, Saitama, Japan). J. Phys. Soc. Jap., 27: 1087-93(Nov. 1969).

The excited states in ^{91}Zr were studied by inelastic proton scattering at 14.52 MeV. Angular distributions for the elastic scattering and for the sixteen excited states were obtained. They have been analyzed by the optical model and the distorted wave Born approximation calculations. The character of some excited states are discussed on the basis of the analysis. (auth)

8917 CHARACTERISTICS OF LEVELS EXCITED IN (n,p) REACTIONS ON HEAVY NUCLEI. Karapetyan, V. V.; Korenman, G. Ya.; Yadrovskii, E. L. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz., 10: 431-2(Aug. 1969). (In Russian).

The cross section of the ^{90}Zr(n,p)^{90}Y reaction was calculated by the impulse approximation for E_n = 150 MeV. The negative parity levels of the ^{90}Y nucleus were considered as isobaric analog states of ^{90}Zr; their wave functions, calculated on the basis of the hole–particle approximation of the shell model with an intermediate bond, were taken from a previous paper. The proton spectrum exhibited a strong maximum at small angles; it corresponds to the excitation of the 1^- 12.3-MeV state of the ^{90}Zr nucleus. The remaining 1^-, 0^-, 2^- states were found to yield weak proton groups with excitation energies from 0 to 13 MeV. The contribution of the positive parity levels was also found to be small. At θ = 10° the total excitation cross section of 11 positive-parity levels within E^* = 10 to 15 MeV was 18.4 mbarn/sterad, while that of the 1^- level with E^* = 12.3 MeV was 47.0 mbarn/sterad. (TTT)

8918 MEASUREMENT OF THE DIRECTIONAL CORRELATION OF THE 1038–605 keV GAMMA CASCADE IN ^{134}Ba. Taylor, H. W.; Singh, B.; Kukoc, A. H.; King, J. D. (Univ. of Toronto). Can. J. Phys.; 47: 2873-7(15 Dec 1969).

The directional correlation of the 1038–605 keV gamma-ray cascade in ^{134}Ba was determined using the well-known 1365–605 keV gamma-ray cascade as a reference. The detection system was a conventional fast–slow coincidence system using a 9 cm^3 cyclindrical Ge(Li) counter and a 5 cm × 5 cm NaI(Tl) counter. The observed correlation coefficients were A_2 = 0.285 ± 0.030, A_4 = −0.002 ± 0.050. The most probable spin sequence for the 1038–605 cascade is 3 (1,2) 2 (2) 0 with a quadrupole content of 35–49% for the 1038-keV transition. (auth) (CANADA)

8919 EFFECT OF THE PIGMY RESONANCE OF THE CALCULATIONS OF THE NEUTRON CAPTURE CROSS SECTION. Brzosko, J. S.; Gierlik, E.; Soltan, A. Jr.; Wilhelmi, Z. (Warsaw Univ.). Can. J. Phys.; 47: 2849-5(15 Dec 1969).

A comparison of the experimental cross sections of the (n,γ) reaction for several nuclei (^{103}Rh, ^{127}I, ^{181}Ta, ^{197}Au) with the compound nucleus model calculations was made. In the formula used for the probability of gamma-ray emission from the compound nucleus, the presence of the well-known giant resonance was accounted for, as well as the presence of the "pigmy resonance" appearing at the energy $E_\gamma \approx 6$ MeV. The agreement with the experimental values is better in this case than when the "pigmy resonance" is neglected. The same conclusions can be obtained from the calculations of the shape of the spectrum of neutron capture and from the Γ_γ/D ratio. (auth) (CANADA)

8920 ISOMERISM IN ^{132}La. Gerschel, Claudie; Perrin, Nils (Institut de Physique Nucleaire, Orsay, France). Compt. Rend., Ser. B, 269: 220-3(July 28, 1969). (In French).

Evidence is presented for an isomeric level 6^- with a period of 25 min at 188.7 keV in lanthanum-132. (tr-auth)

Nuclear Theory

Refer also to abstracts 8319, 8564, 8651, 8669, 8689, 8690, 8837, 8840, 8849, 8863, 8868, and 8869.

8921 (COO–427-96) POSSIBLE SCHEME FOR ANALYZING DIRECT NUCLEAR REACTIONS. Shanley, Paul E. (Notre Dame Univ., Ind. Dept. of Physics). [1969]. Contract AT(11-1)-427. 12p. Dep. CFSTI.

A technique of data analysis familiar in nucleon-nucleon scattering is proposed for use in the extraction of spectroscopic information from direct nuclear reactions. The method is shown to be successful in analyzing some artificial data generated by a soluble three-body model of deuteron stripping. (auth)

8922 (JINR–P4-4511) OPTICAL MODEL WITH THE SOURCE. Fenin, Yu. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1969. 13p. (In Russian). Dep. CFSTI (U. S. Sales Only).

In the generalized nuclear reaction theory with an account of particle rearrangement, the sources appear naturally in the Schrödinger equation. Introduction of the source into an ordinary optical model describes a more fine structure in the dependence of the neutron strength functions on the atomic weight. (auth)

8923 (NP–18073) LOWER BOUND TO THE MAGNITUDE OF THE NUCLEAR BINDING ENERGIES OF DOUBLY MAGIC NUCLEI. Note No. 234. Badalyan, A. M.; Calogero, F.; Simonov, Yu. A. (Rome Univ. (Italy). Istituto di Fisica). 24 Jul 1969. 43p. Dep. CFSTI (U. S. Sales Only).

A simple lower bound for the magnitude of the binding energies of (suitably defined) doubly magic nuclei is presented. It states that these quantities are minorized by the corresponding quantities evaluated for a two-body problem with an effective potential that is an appropriate (and explicitly defined) integral transform of the original two-body nucleon-nucleon central potentials. (auth)

8924 (NP–18075) NECESSARY CONDITIONS FOR SATURATION OF NUCLEAR FORCES. Note No. 225. Calogero, F.; Simonov, Yu. A. (Rome Univ. (Italy). Istituto di Fisica). 16 Jun 1969. 31p. Dep. CFSTI (U. S. Sales Only).

Rigorous conditions are given that must be satisfied by the nuclear interaction in order to be consistent with saturation. They apply to general potential shapes (possibly different in different spin-isospin states). The treatment includes direct, exchange, tensor and spin-orbit interactions described by two-body local velocity-independent potentials. (auth)

8925 (ORNL-tr-1704) CALCULATION OF ALPHA–NUCLEON CASCADES. Cohen, J. P. Translated by R. Gregg Mans-

field (Oak Ridge National Lab., Tenn.), from Nucl. Phys., 84: 316-36(1966). 22p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 20: 32455.

8926 (ORNL-tr-2235) INTERACTION CROSS SECTIONS OF HIGH ENERGY PARTICLES WITH ATOMIC NUCLEI. Eliseev, S. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). Translated for Oak Ridge National Lab., Tenn., from report JINR-P2-4509. 7p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 42690.

8927 (RLO-1388-105) AN IMPROVED METHOD OF CALCULATING FINITE RANGE CORRECTIONS IN TWO NUCLEON TRANSFER REACTIONS. Chant, N. S.; Mangelson, N. F. (Washington Univ., Seattle. Dept. of Physics). [1969]. 31p. Dep. CFSTI.

A method is developed for calculating finite range corrections in two nucleon transfer reactions. Certain approximations of currently used methods are eliminated and no new approximations are introduced. Sample distorted wave Born approximation calculations are presented. Changes due to the improvement in calculating the finite range corrections are found to be large. (auth)

8928 (UCRL-50755) INCIDENT ENERGY DEPENDENCE OF FISSION SPECTRA. Doyas, R. J.; Howerton, R. J. (California Univ., Livermore. Lawrence Radiation Lab.). Sep 1969. 7p. Dep. CFSTI.

Terrell's relationship for a fission neutron spectrum is $\bar{E}' = (3/2)\, T_m \approx 0.75 + 0.65[\bar{\nu}(E) + 1]$, where $\bar{E}'$ is the mean energy of the emitted neutrons, T_m is the corresponding Maxwellian temperature, and $\bar{\nu}$ is the average number of neutrons emitted in a fission event for incident neutrons of energy E. Previous comparisons of this equation with experimental results, which have shown considerable discrepancies and cast some doubt on the equation's validity, used a value of $\bar{\nu}(E)$ corresponding to the total emission of neutrons from a fission event. These comparisons are replotted here using a value of $\bar{\nu}(E)$ corresponding to only the fission-produced neutrons, and much better agreement is found between the Terrell equation and experiment. It is concluded that the equation gives a good description of $\bar{E}$ or T_m for all incident energies between thermal and 14 MeV (and for spontaneous fission) and is applicable to all fissile isotopes. (auth)

8929 ANALOGS, ANTI-ANALOGS, AND SO FORTH. Macfarlane, M. H.; Schiffer, J. P. (Argonne National Lab., Ill.). Comments Nucl. Particle Phys., 3: 107-11(July-Aug. 1969).

The existence of isobaric analog and anti-analog states in heavy nuclei is discussed. Certain aspects of spectroscopic studies are examined and current directions of study are surveyed. (J.W.R.)

8930 CALCULATION OF NUCLEON-NUCLEUS SCATTERING PROCESSES. I. Weidenmueller, Hans A. (Institut fuer Theoretische Physik, Heidelberg). Comments Nucl. Particle Phys., 3: 112-19(July-Aug. 1969).

Some problems encountered in calculations of compound resonances in nucleon-nucleus scattering processes using the microscopic shell model are reviewed, and some of the results obtained in such calculations are discussed. A semiquantitative interpretation of the results in terms of the matrix elements of the shell-model Hamiltonian is presented, and the results are compared with standard bound-state calculations. Processes involving the compound nuclei ^{15}O and ^{16}N are discussed in some detail. (J.W.R.)

8931 NUCLEAR STRUCTURE. I. THEORETICAL FRAMEWORK. Baranger, Michel (Massachusetts Inst. of Tech., Cambridge). Comments Nucl. Particle Phys., 3: 120-31(July-Aug. 1969).

The theoretical foundations for the current understanding of nuclear structure are examined. Emphasis is on establishing the language and defining a framework which will be expanded in later publications. (J.W.R.)

8932 COLLECTIVE MOTION OF ROTATIONAL INVARIANT SYSTEM COMPOSED OF N-PARTICLES. Goto, Tetsuo (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 42: 581-99(Sept. 1969).

Collective coordinates of rotational motion are studied by means of the canonical transformation. It is shown that the Hamiltonian is equivalent to that of Tamura, Nataf and Villars [T. Tamura, Nuovo Cim. 4 (1956), 1307; R. S. Nataf, Nucl. Phys. 2 (1957), 497; F. Villars, Annual Review of Nuclear Science (Annual Review Inc.) Vol. 7 (1957), p. 185]. Further investigation is carried out and it shows that a rotation-like collective motion is introduced besides rotation as a whole of a system and even in a spherically symmetric case one has rotational levels. Interest is focussed on collective momenta rather than collective coordinates and they are generators of GL(3). (auth)

8933 OPTICAL POTENTIAL FOR DEUTERON SCATTERING BY THE NUCLEUS. Suzuki, Takehiko (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 42: 732-4(Sept. 1969).

An optical potential for deuteron-nucleus scattering is derived which is expressed as the sum of the effective interactions of the neutron and proton averaged over the internal state of the deuteron. The effective interactions are introduced in symmetric form by a method analogous to the multiple scattering formulation. (J.W.R.)

8934 STUDY OF ^8Be IN THE MOLECULAR ORBIT MODEL. Kubodera, Kuniharu; Ikeda, Kiyomi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 42: 740-2(Sept. 1969).

An attempt is made to describe the cluster structure of light nuclei in terms of the single-particle picture. Such a procedure should emphasize the differences and connections between the cluster model and the shell model. A Hartree-Fock study is made of ^8Be to determine whether or not single-particle orbits can be obtained which will account for the density localization. Acceptable orbits with two centers of the density distribution were found. (J.W.R.)

8935 EXCHANGE EFFECTS RESPONSIBLE FOR CLUSTER STATES AND ONE-PARTICLE FIELD IN LIGHT NUCLEI. Tamagaki, Ryozo (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 42: 748-50(Sept. 1969).

It is shown that there are two characteristic series or phases of energy levels in light nuclei. These correspond to the single-particle or shell series and the α-chain series. (J.W.R.)

8936 THE ANALYSIS OF ROTATION BANDS IN EVEN-EVEN NUCLEI. Begzhanov, R. B.; Belen'kii, V. M. (Inst. Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 51-7(1969). (In Russian).

The rotation bands of the excited states in even-even nuclei were analyzed by the method of least squares according to the formula of Ejiri and the two-term formula of Bohr-Mottelson. (tr-auth)

8937 EFFECTS OF COMPOUND PARTICLES IN NON-RELATIVISTIC VERTEX PARTS. Beidavi, M. M. Al; Dolinskii, E. I.; Turovtsev, V. V. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 4, 17-23(July-Aug. 1969). (In Russian).

Form factors of triple-beam nonrelativistic vertex parts (amplitudes of virtual decays of A → B + a) considered in the calculations of amplitudes of direct nuclear reactions were analyzed within the limits of the diagram theory. Simple examples were used to show that the effects of virtual dissociation and the synthesis of component particles B and a in the decay process A → B + a influence considerably the magnitudes of the vertex form factors and the absolute magnitudes and shapes of differential cross sections of direct reactions calculated by means of diagram formalism. (tr-auth)

8938 INFLUENCE OF LOW-LEVEL COLLECTIVE STATES WITH NEGATIVE PARITY ON STRUCTURE OF DIPOLE RESONANCE. Zhivopistsev, F. A.; Moskovkin, V. M.; Nagar, N. El; Yudin, N. P. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 4, 94-5(July-Aug. 1969). (In Russian).

An analysis was made of the bond between the partially vacant states and particle-vacancy excitations constructed over the collective states with negative parities 3^- or 5^-. It was found that, during the formation process of dipole resonance structure, the bond played an especially, significant role in the magic nuclei in which the low-level collective states of positive even parity were absent. The doubly magic nucleus ^{40}Ca was examined and the effects of the bond were calculated. A graphical description is given of energy and intensity of dipole levels and the cross section of photoabsorption. It was concluded that in heavy nuclei the states enter directly into the dipole resonance region and affect, significantly, its structure. (R.V.J.)

8939 TWO-BUMP BARRIER AND THE NEUTRON-INDUCED NUCLEAR FISSION. Gai, E. V.; Ignatyuk, A. V.; Rabotnov, N. S.; Smirenkin, G. N. Yadern. Fiz.; 10: 542-8 (Sep 1969). (In Russian).

The energy dependence of the penetration for a two-bump potential barrier with a well between the maxima is calculated in the quasiclassical approximation. It is shown that the penetration oscillates sharply, increasing to the maxima for energies near the quasilevels of the well. The results are applied for analysis of the experimental data on neutron-induced nuclear fission. (auth)

8940 SPIN ORBITAL INTERACTION IN NUCLEI. Guman, V. N.; Sliv, L. A.; Kharitonov, Yu. I. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz.; 10: 526-36(Sep 1969). (In Russian).

Properties of the two-body spin-orbital interaction of particles in nuclei are investigated. It is shown that the observed spin-orbital splittings of nuclei which have one particle or one hole beyond the double closed levels, are described by unified spin-orbital forces acting between all the particles. The range r^0 and the potential depth v_{LS} of the spin-orbital forces which are r_0 = 0.8 f, v_{LS} = −15 MeV when their radial dependence is of the form of the Yukawa potential and r_0 = 1.0 f, v_{LS} = −20 MeV when they are of the form of the Gauss potential. (auth)

8941 DEVIATIONS FROM STATISTICAL DESCRIPTION OF NEUTRON-LEVEL SPACING DISTRIBUTIONS FOR INTERMEDIATE AND HEAVY NUCLEI. Sukhoruchkin, S. I. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 10: 496-504(Sep 1969). (In Russian).

Analysis of the correlation properties of the resonance neutron levels for a large number of nuclei, is described. The method was to compare the deviations from the statistical distributions for low-lying and highly-excited nuclear levels, and this was applied to the energy intervals of few keV. In both groups of the levels, systematical correlations with the same parameters are found, indicating that the conditions of the statistical model are not fulfilled completely for the excitation energies close to the neutron binding energy. A model is discussed where these correlations (the fine structure of the level spacing distributions) result in a structure with a scale of few eV. Such a structure is observable in the neutron-level spacing distributions for heavy N-even target nuclei. (auth)

8942 LIMITS FOR NEUTRON STABILITY OF NUCLEI. Vinogradov, B. N.; Nemirovskii, P. E. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 10: 505-8(Sep 1969). (In Russian).

Limit for the neutron stability of nuclei is studied again, on basis of the shell model with account of the symmetry term in the nuclear potential. One-particle, as well as hole, states are analyzed. For even-even nuclei the energy of pair correlation is calculated and added to the bound energy of the odd nucleus. As a result, one is able to calculate the stability of the even-even nuclei (in case of the hole levels of the odd nuclei) with respect to the emission of one or two neutrons. (auth)

8943 EQUATION FOR SELFCONSISTENT NUCLEAR POTENTIAL. Babikov, V. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 10: 509-18(Sep 1969). (In Russian).

An exactly solvable statistical model of finite nuclei is presented. The existence of an attractive potential due to a scalar meson field induced by nucleons is assumed. A nonrelativistic model Hamiltonian for the system of interacting meson and nucleon fields is constructed. Corresponding nonlinear equations for the nuclear potential and nuclear density are solved analytically for a definite choice of parameters. The relation between the density and the potential appears to be identical to the self-consistency of the Thomas–Fermi method. The volume term of the nucleon binding energy in the nuclear matter is obtained. Explicit expressions for distributions of the potential and density in spherical and deformed nuclei are found. Mesonic mass and the coupling constant are estimated comparing theoretical results with the experimental data on the thickness of the surface layer of nuclei and the nuclear matter density. (auth)

8944 CALCULATIONS OF THE INTERACTION OF FAST DEUTERONS WITH NUCLEI. Gudima, K. K. pp 3-6 of Issledovaniya po Kvantovoi Teorii Sistem Mnogikh Chastits. Moskalenko, V. A. Kishinev, USSR, Inst. of Mathematics and Computer Center, 1969. (In Russian).

Two interaction schemes, namely "2-center" and "d-whole," are shown to be effective in calculating the characteristics of high-energy deuteron–nuclear reactions. (tr-auth)

8945 CALCULATION OF BOUND STATES IN THE STRONG-COUPLING APPROXIMATION. Simenog, I. V. (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 14: 184-93(Feb. 1969). (In Russian).

Physical characteristics of bound states of the two-body problem: ground state energy, energy levels of excitation states and root-mean-square radius—are studied with large coupling constants g. The problem of bound states of mononucleon systems is considered. (auth)

8946 SCHEMATIZATION OF SCATTERING AMPLITUDE AND WAVE FUNCTION FOR POTENTIAL RESONANCE USING WEINBERG'S QUASIPARTICLES. Huby, R. (Univ. of Liverpool). Nucl. Phys.; A138: 442-56(1969).

The problem is to describe the resonant scattering of a partial-wave of angular momentum l (non zero) in an attractive potential V(r), by a schematic approximation which displays energy-dependence of Breit-Wigner type and which possesses other specified desirable features. The idea is to work at real, positive energies E (without analytic continuation), and to produce a good approximation not only for the scattering amplitude but also for the scattering wave-function $\psi(E,r)$, the latter to depend smoothly on r (no joining radius), to have a "nearly bound" shape within the potential, and to have a proper long-distance tail. This is achieved through Weinberg's "quasiparticle" decomposition of the equations, which makes use of the eigenfunctions and eigenvalues of the Lippmann-Schwinger kernel. Two alternative schemes are used: Weinberg's original T-matrix one, and a modified K-matrix one, the latter being more accurate. For the scattering function $S_l(E)$ formulas are obtained which exhibit a background and a resonance contribution, the formula in the K-scheme being structurally very close to that of R-matrix theory. The width Γ_0 in the T scheme is $2\pi|\langle\psi_0(E_0)|V|\chi(E_0)\rangle|^2$ where $\psi_0(E_0,r)$ is the Weinberg quasiparticle wave function (normalized) and $\chi(E_0,r)$ is a free wave function at the a resonant term proportional to $\psi_0(E,r)$, bearing an amplitude showing Breit-Wigner energy dependence. The interpretation of the formulas is that the resonance mechanism is associated with a discrete resonance state, viz., the quasiparticle state $\psi_0(E,r)$, which the particle from the free wave makes a transition into, and out of again. (auth)

8947 DOUBLE-CENTRE OSCILLATOR AND ITS APPLICATION TO FISSION. Holzer, Peter; Mosel, Ulrich; Greiner, Walter (Univ., Frankfurt am Main). Nucl. Phys.; A138: 241-52(1969).

A single-partial potential appropriate for the description of the nuclear fission process was investigated. This potential is based on a two-center harmonic oscillator and includes the proper boundary condition for the ground state of the fissioning nucleus as well as for the two separated fragments. Therefore, this potential may be directly used in a Hamiltonian for a schematic fission model. The single-particle solutions of the Schroedinger equation of this potential were found by a matching procedure. They are given analytically, Therefore these wave functions are very suitable as a basis for the treatment of potentials with similar shapes. The collective potential energy surface calculated within the two-center shell model has the proper asymptotic behavior, e.g., the potential energy decreases for large deformations (separations). (auth)

8948 EIGENFUNCTION APPROXIMATION FOR THE TWO-BODY t-MATRIX. Osborn, T. A. Oxford Univ.). Nucl. Phys.; A138: 305-20(1969).

An eigenfunction analysis of the off-shell partial wave two-body t-matrix is presented. The intention is to construct a general finite rank separable approximation for the two-body t-matrix that is suitable for use in numerical solutions of Faddeev's equation. This is done by extending the single term separable approximation suggested by Kowalski and Noyes. It is proved that if the potential satisfies the conditions stated by Faddeev then the kernel in the Kowalski-Noyes equation, $\Lambda(s)$, is compact and has an eigenfunction representation. The extension of the Kowalski-Noyes approximation is to add additional separable terms composed of the eigenfunctions of $\Lambda(s)$. Finally, it is shown that the non-physical poles which occur in the single term separable approximation are cancelled by these additional separable terms. (auth)

8949 SHELL EFFECTS ON LEVEL DENSITY IN NEAR DOUBLY MAGIC NUCLEI. Gadioli, E.; Iori, I.; Molho, N.; Zetta, L. (Univ., Milan). Nucl. Phys.; A138: 321-36(1969).

A simple model to describe the level density of nuclei near the doubly magic nucleus ^{208}Pb was developed. A doubly magic nucleus is considered as a two-fermion gas with an energy gap at the Fermi energy. This model explains both the low- and high-energy level density behavior. The high-energy behavior is tested by analyzing α-particle decay rates from excited nuclei. The arguments developed should be important in the analysis of fission data and of Monte Carlo calculations of direct nucleon emission. (auth)

8950 SPURIOUS SOLUTIONS OF THREE-PARTICLE EQUATIONS. Kazaks, Peter A. (Univ. of California, Davis. Ohio Univ., Athens). Nucl. Phys.; A138: 347-52(1969).

A new criterion is presented for the existence of spurious bound states in the equation for three-body scattering proposed by Weinberg. It is applied to the s-wave Yamaguchi potential with the result that spurious solutions exist at real negative energies for certain values of the parameters of this realistic potential. (auth)

8951 COORDINATE-SPACE STUDY OF NUCLEAR SELF-CONSISTENT FIELDS. I. THEORETICAL CONSIDERATIONS. Stingl, M. (Weizmann Inst. of Science, Rehovot, Israel). Nucl. Phys.; A138: 353-86(1969).

The nonlocal one-body potentials arising in matrix form from nuclear Hartree-Fock and Hartree-Bogolyubov calculations are described in coordinate space. It is pointed out that nuclear nonlocal potentials possess finite Hilbert-Schmidt norms, and it is shown how to use this property for invariant definitions of spatial quantities characterizing a nonlocal potential. In particular, a general definition of the concept of mean nonlocality length is given. Using the formal device of generalized delta functions, an expansion of a potential about its local component is derived whose coefficient functions constitute a natural generalization of the concept of local potential function. The lowest-order members of this expansion permit a state-independent, approximate, graphical description of self-consistent fields. Its relation to the effective-mass approximation is discussed. (auth)

8952 ON THE THREE-NUCLEON GROUND-STATE WAVE FUNCTION. I. THE CONSTRUCTION OF THE WAVE FUNCTION AND THE DERIVATION OF THE ONE-PARTICLE MATRIX ELEMENTS CONTRIBUTIONS. Bijedic, N.; Maric, Z. (Boris Kidric Inst., Belgrade). Fizika (Zagreb), 1: 219-32(July 1, 1969).

The group-theoretical arguments are used to write the three-nucleon ground state wave function. The obtained expressions are rewritten in the spherical coordinates convenient for the application of the angular momentum algebra and for the spatial integration. The formulas for different interference terms in the case of the one-particle Hamiltonian are given explicitly. (auth)

8953 RADIOACTIVITY CALCULATIONS. Onega, Ronald J. (Virginia Polytechnic Inst., Blacksburg). Amer. J. Phys., 37: 1019-22(Oct, 1969).

Three problems in radioactive buildup and decay are presented and solved. Matrices are introduced for the solution of the second problem, and the third example deals in a simple way with flux depression. (auth)

8954 ELEMENTS OF THE THEORY OF NUCLEAR REACTIONS. II. INTRODUCTION TO MANY-BODY THEORY OF NUCLEAR REACTIONS. Guiasu, Ileana (Bucharest Inst. of Nuclear Physics). Stud. Cercet. Fiz., 21: 33-71(1969). (In Rumanian).

Several theories may be used in principle to calculate the scattering matrix of any nuclear reaction. F. Feshbach's unified theory is especially well suited for treating the dynamics of a complex system. The theory is applied for a specific case by extending the shell model, as was done in the papers of H. Weidemuller, C. Bloch, and others. The concepts established by these authors are identified on simplified examples, introducing the formal results of Feshbach's theory and indicating the technique used for the continuous extension of the shell model. The direct reactions are examined in detail. A chapter is devoted to the second quantization method which makes it possible to carry out calculations with particle-whole states or to use theorems based on the field theory for nuclear reactions. Application of the theory is exemplified by presenting R. Lemmer and C. Shakin's calculations for the elastic scattering reaction $^{15}N + n \rightarrow {}^{15}N + n$. (TTT)

8955 ISOSPIN STRUCTURE OF PAIRING COLLECTIVE MOTION. Bayman, B. F.; Bes, D. R.; Broglia, R. A. (Univ. of Minnesota, Minneapolis). Phys. Rev. Lett.: 23: 1299-1302 (1 Dec 1969).

The isospin degree of freedom of the pairing force is studied in the framework of the rotational ($\Delta \neq 0$) and vibrational ($\Delta = 0$) models. The magnitude Δ is the BCS gap parameter. The predictions of the two models concerning two-nucleon transfer reactions and energy levels are compared and contrasted. Some of the available experimental material around ^{56}Ni is discussed in this framework. Further experiments are suggested which would help decide between the coupling schemes. (auth)

8956 REARRANGEMENT EFFECTS AND THE PARAMETRIZATION OF THE EFFECTIVE FIELD IN NUCLEI. Meldner, H. (Univ. of California, La Jolla); Shakin, C. M. Phys. Rev. Lett.: 23: 1302-6(1 Dec 1969).

A simple parametrization of the nonlocal effective field in nuclei is provided. The parameters as determined by fitting the properties of nuclear matter are quite similar to those which have been shown to yield good results for the size and binding energies of finite nuclei throughout the periodic table. It is shown that the self-consistent single-particle energies are significantly different from the separation energies (rearrangement effect) and consequences for structure calculations and particle knock-out experiments are discussed. (auth)

8957 NUCLEAR PENETRABILITY AND PHASE SHIFT SUBROUTINE. Smith, William R. (Trinity Univ., San Antonio). Comput. Phys. Commun., 1: 106-12(Oct. 1969).

The subroutine SCAT numerically integrates the radial Schroedinger equation including a complex central Woods–Saxon potential and spin-orbit coupling for the case of a particle scattered by the nuclear and Coulomb force field of a target nucleus. The subroutine provides penetrabilities needed in the treatment of compound nucleus reactions and also phase shifts necessary to calculate elastic scattering and polarization angular distributions and reaction, total elastic and total cross sections. (auth)

8958 INVERSE PROBLEM OF THE THEORY OF CHARGED-PARTICLE SCATTERING. Gugushvili, E. I.; Mentkovskii, Yu. L. (Inst. of Theoretical Physics, Kiev). Ukr. Fiz. Zh., 14: 1252-63 (Aug. 1969). (In Russian).

A theory is constructed for reproduction of the nuclear potential from data on nuclear-Coulomb scattering. The Riemann method is widely used for finding solutions of partial differential equations (of the hyperbolic type); an explicit spectral representation is found for the corresponding Riemann function. (auth)

8959 TRANSFER REACTIONS ON PSEUDONIUM ISOTOPES. Kolitveit, K. (Michigan State Univ., East Lansing). Phys. Lett., 30B: 386-9(Nov. 10, 1969).

One and two particle transfer reactions on the pseudonium isotopes are considered. It is shown that selected one particle transfer transitions and the ratio of $J = 0$ and $J = 2$ two particle transitions are sensitive to core excitations. (auth)

8960 COLLECTIVE MODES ASSOCIATED WITH NUCLEAR PAIR CORRELATIONS. Jolos, R. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Lett., 30B: 390-2(Nov. 10, 1969).

The general properties of the pair addition and the pair removal modes are investigated within the framework of the microscopic model with the pairing forces. (auth)

8961 A NEW TREATMENT OF THE COLLECTIVE NUCLEAR HAMILTONIAN. Gneuss, G.; Mosel, U.; Greiner, W. (Univ., Frankfurt am Main). Phys. Lett., 30B: 397-9(Nov. 10, 1969).

A collective nuclear Hamiltonian which is able to describe the case of a spherical harmonic vibrator nucleus as well as that of a permanently deformed rotator is diagonalized in the basis of the five-dimensional harmonic oscillator defined in the laboratory system. (auth)

8962 A COMMENT TO THE BHMM ANALYSIS OF THE DEUTERON STRIPPING. Dobes, J. (Nuclear Research Inst., Rez, Czech.). Phys. Lett., 30B: 404-5(Nov. 10, 1969).

The BHMM theory of deuteron stripping reactions is analyzed and subjected to criticism. Its use in analyses of reactions with spectroscopic factors close to the unity is questioned. (auth)

8963 A STUDY OF THE EFFECT OF WEIGHT FUNCTIONS ON ENERGY AVERAGES. Ullah, N. (Univ. of Toronto). Phys. Lett., 30B: 379-81(Nov. 10, 1969).

A class of weight functions, parameterized to yield Lorentz weight function in one extreme and a weight function close to the box weight function in the other, is used to study the effects of weight functions on energy averages. It is shown that if, for each choice of weight functions, the maximum is taken to be equal to the height of the box weight function, then the energy averages are almost independent of the weight functions. (auth)

REACTOR TECHNOLOGY

Commercial Power Reactors

Refer also to abstracts 7545, 7583, 7616, 7621, 7876, 7880, 7921, 8148, 9108, and 9154.

8964 (AERI–32) ESTIMATION OF NUCLEAR POWER COSTS IN KOREA. Cha, Jong Hee (Atomic Energy Research Inst., Seoul (South Korea)). [1969]. 15p. (CONF-691020–1). Dep. CFSTI (U. S. Sales Only).

From Symposium on Nuclear Power Costs and Economics Development, Istanbul, Turkey.

Energy resources in South Korea are tabulated, and total energy demand to 1980 is estimated. A feasibility and cost analysis of installing nuclear power plants is presented using a 500 MW(e) light water reactor as the base case. (H.D.R.)

8965 (APDA-NTS–19) MEASURED AND CALCULATED RESPONSE OF NEUTRON SPECTRUM INDICES IN THE ENRICO FERMI FAST BREEDER REACTOR. Horne, R. E.; Page, E. M.; Daavettila, D. A.; Montfort, J. C. (Atomic Power Development Associates, Inc., Detroit, Mich.). Oct 1969. 63p.

Comparison of measured threshold-type reaction rate distributions with calculations indicate that standard multigroup techniques for the calculation of high energy fluxes at distances of the order of 75 cm from the core boundary can be used with confidence. These data together with the data of the low energy activation detectors $^{55}Mn(n,\gamma)$ and $^{197}Au(n,\gamma)$ support earlier ^{235}U scans in showing that low energy reaction rates rise severely near the edge of the blanket. These rises are being confirmed by temperature measurements. Absolute reaction rates obtained with fission counters support the general contention for fast reactors that the lower energy flux is greater than calculated. A reverse trend is indicated for the higher energy fluxes, but accurate spectrum measurements were found to be hampered by uncertainties in counter loadings and difficulties in power normalization. 14 references. (auth)

8966 (DOCKET-1153–4) HALLAM NUCLEAR POWER FACILITY. Operational Environmental Survey Program. Quarterly Report No. 33, July–September 1969. (Consumers Public Power District, Hallam, Nebr.). 3 Nov 1969. 3p. Dep. CFSTI.

8967 (DOCKET-1155–15) MALFUNCTION OF FUEL HANDLING HOIST. LACBWR Incident Report No. DPC 69-2. (Dairyland Power Cooperative, La Crosse, Wis.). 20 Nov 1969. 3p. Dep. CFSTI.

8968 (DOCKET-1155–17) LA CROSSE BOILING WATER REACTOR. Monthly Operational Report No. 28, October 1969. (Allis-Chalmers Mfg. Co., Bethesda, Md. Atomic Energy Div.). 12 Dec 1969. 34p. (ACNP–69511). Dep. CFSTI.

8969 (DOCKET-50003–15) INDIAN POINT UNIT NO. 1. Supplementary Information for Full-Term Operating License DPR-5. (Consolidated Edison Co. of New York, Inc., New York). [nd]. 373p. Dep. CFSTI.

The operating history of the reactor from September 1962 to September 1968 is described. Requirements and responsibilities for reactor personnel are listed. Personnel qualifications are also listed. Design requirements for the reactor protection systems are analyzed. Quality control standards for fabrication and inspection of reactor components and systems are described. Hazards related to site flooding and gas pipeline accidents are analyzed. Fire protection systems are described. Operating characteristics of the reactor core are discussed. The control system and required instrumentation are described. Design requirements for radiation monitoring systems are presented. The environmental monitoring program is described. Engineered safeguards and emergency power systems are analyzed. Inspection and testing procedures for the containment and emergency core cooling systems are described. (D.C.C.)

8970 (DOCKET-50010–57) DRESDEN NUCLEAR POWER STATION, UNIT 1. [Failure of a Safety System Sensor to Operate Normally During a Routine Test]. (Commonwealth Edison Co., Chicago, Ill.). 4 Nov 1969. 1p. Dep. CFSTI.

8971 (DOCKET-50010–58) [DRESDEN NUCLEAR POWER STATION, UNIT 1]. License No. DPR-2: Proposed Change No. 19. (Commonwealth Edison Co., Chicago, Ill.). 12 Nov 1969. 13p. Dep. CFSTI.

Design parameters for cobalt radiation target cans are presented. Operational procedures required for the radiation target cans are described. (D.C.C.)

8972 (DOCKET-50010–59) [DRESDEN NUCLEAR POWER STATION, UNIT 1]. License No. DPR-2: Proposed Change No. 20. (Commonwealth Edison Co., Chicago, Ill.). 20 Nov 1969. 4p. Dep. CFSTI.

Revised requirements for stack discharge rates are described. (D.C.C.)

8973 (DOCKET-50018–7) VALLECITOS BOILING WATER REACTOR. Annual Report on Operating Experience, February 1, 1960–January 31, 1961. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 17 Apr 1961. 10p. Dep. CFSTI.

8974 (DOCKET-50018–8) VALLECITOS BOILING WATER REACTOR. [Final Safety Analysis Report], Amendment 46. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 26 Jun 1961. 55p. (GEAP–3751). Dep. CFSTI.

Design parameters and operating safety limits for the E-SADE in-pile loop are presented. Design parameters for pellet shaped UO_2 rod type fuel elements are listed. The in-pile loop cooling system is described. Physics measurements for the loop are presented. (D.C.C.)

8975 (DOCKET-50029–109) YANKEE NUCLEAR POWER STATION. Operation Report No. 106, October 1969. (Yankee Atomic Electric Co., Boston, Mass.). 20 Nov 1969. 8p. Dep. CFSTI.

8976 (DOCKET-50029–110) YANKEE NUCLEAR POWER STATION. Operation Report No. 107, November 1969. (Yankee Atomic Electric Co., Westboro, Mass.). 19 Dec 1969. 10p. Dep. CFSTI.

8977 (DOCKET-50130–3) PATHFINDER GENERATING PLANT, SIOUX FALLS, SOUTH DAKOTA. License No. DPR-11. Six-Month Operating Report No. 7. Plant Operating Experience, May 14–November 14, 1969. (Northern States Power Co., Minneapolis, Minn.). 2 Dec 1969. 10p. Dep. CFSTI.

8978 (DOCKET-50146–44) [SAXTON REACTOR]. Operating Experience Report, March 1–August 31, 1969. (Saxton Nuclear Experimental Corp., Pa.). 3 Nov 1969. 42p. Dep. CFSTI.

8979 (DOCKET-50146–45) [SAXTON REACTOR]. Emergency Preparedness Plan. License No. DPR-4: Amendment 8 to Change Request No. 32. (Saxton Nuclear Experimental Corp., Pa.). 17 Nov 1969. 38p. Dep. CFSTI.

Topics discussed include: organizational responsibilities; high radiation evacuation plan; containment vessel evacuation; unrestricted area release of radionuclides; fire emergency; personnel injury involving radiation or contamination; hospitalization of radiation casualties; radioactive spills; abnormal personnel exposure; non-radiological industrial accidents; reporting radiological incidents; recovery following initiation of evacuation plan; emergency communications; outside agencies and emergency reserve of personnel and equipment; periodic review, updating, and drills; public notification of accident; call lists; and indoctrination and training. (D.C.C.)

8980 (DOCKET-50146–46) [SAXTON REACTOR]. License No. DPR-4: Amendment 9 to Change Request No. 32. (Saxton Nuclear Experimental Corp., Pa.). 26 Nov 1969. 6p. Dep. CFSTI.

Thermal and hydraulic analyses of hot channel factors are presented. (D.C.C.)

8981 (DOCKET-50146–47) SAXTON REACTOR. License No. DPR-4: Amendment 2 to Change Reports 15 and 16. (Saxton Nuclear Experimental Corp., Pa.). 5 Dec 1969. 3p. Dep. CFSTI.

Additional information is presented on the proposed pressure tests to demonstrate the integrity of the pressurizer safety valve water seal installation and the spilled coolant recirculation system installation. The information concerns the conditions considered in determining the maximum pressure capability of the reactor cooling system. (H.D.R.)

8982 (DOCKET-50146–48) SAXTON REACTOR. License No. DPR-4: Amendment 7, Technical Specifications Change No. 34. (Saxton Nuclear Experimental Corp., Pa.). 10 Dec 1969. 74p. Dep. CFSTI.

The Saxton Reactor operating license is amended to permit operation at steady-state power levels up to 28 MW(t). (H.D.R.)

8983 (DOCKET-50171-13) [PEACH BOTTOM ATOMIC POWER STATION]. Application for Extension of License Expiration Date. (Philadelphia Electric Co., Pa.). 20 Nov 1969. 6p. Dep. CFSTI.

8984 (DOCKET-50171-14) [PEACH BOTTOM ATOMIC POWER STATION]. Request for Change in Technical Specifications (No. 9). (Philadelphia Electric Co., Pa.). 17 Nov 1969. 56p. Dep. CFSTI.

Fuel pin radiation testing requirements are presented. Modifications in fuel element design parameters are described. (D.C.C.)

8985 (DOCKET-50171-15) [PEACH BOTTOM ATOMIC POWER STATION]. Request for Change in Technical Specifications (No. 10). (Philadelphia Electric Co., Pa.). 5 Dec 1969. 4p. Dep. CFSTI.

A change is requested in the limits on reactivity and power anomalies for the Peach Bottom Reactor. (H.D.R.)

8986 (DOCKET-50171-16) PEACH BOTTOM ATOMIC STATION, UNIT NO. 1. Determination of Reactivity Response to Operational Input Perturbations. (Philadelphia Electric Co., Pa.). Sep 1969. 56p. Dep. CFSTI.

In order to establish the reliability of operational determinations of core reactivity, an analysis of the instrument and calculational uncertainties which exist in such determinations was performed. The details of this analysis are presented to support a request for changes in the limits on reactivity and power anomalies. (H.D.R.)

8987 (DOCKET-50171-17) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Reactivity Anomalies. (Philadelphia Electric Co., Pa.). Nov 1969. 21p. Dep. CFSTI.

The reactivity monitoring program at the Peach Bottom Reactor is summarized and the reliability of the reactivity determinations are discussed. This discussion is presented to support a request for changes in the limits on reactivity and power anomalies. (H.D.R.)

8988 (DOCKET-50171-18) PEACH BOTTOM ATOMIC POWER STATION, [UNIT 1]. Monthly Operations Report No. 44, October 1969. (Philadelphia Electric Co., Pa.). 15 Dec 1969. 17p. Dep. CFSTI.

8989 (DOCKET-50206-17) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Technical Specifications. (Southern California Edison Co., Camp Pendleton, Calif. San Diego Gas and Electric Co., Calif.). 21 Jun 1966. 80p. Dep. CFSTI.

Limiting conditions for reactor operation are described. Design requirements for the emergency core cooling and emergency injection systems are analyzed. Safety limits for the control system instrumentation are described. Inspection and testing schedules for components and systems are included. (D.C.C.)

8990 (DOCKET-50206-18) SAN ONOFRE NUCLEAR GENERATING STATION, SAN ONOFRE, CALIFORNIA. Operation Report, April 1969. (Southern California Edison Co., Los Angeles). May 1969. 6p. (NYO-3270-25). Dep. CFSTI.

8991 (DOCKET-50213-20) [CONNECTICUT YANKEE ATOMIC POWER PLANT]. License No. DPR-14: Technical Specifications, App. A, Proposed Change No. 12. (Connecticut Yankee Atomic Power Co., Boston, Mass.). 4 Nov 1969. 33p. Dep. CFSTI.

Modifications for the emergency core cooling and emergency power systems are presented. Revised core hydraulic and thermal characteristics are described. (D.C.C.)

8992 (DOCKET-50213-22) HADDAM NECK PLANT, HADDAM, CONNECTICUT. Operation Report No. 69-10, October 1969. (Connecticut Yankee Atomic Power Co., Boston, Mass.). 21 Nov 1969. Contract AT(30-1)-3250. 14p. (NYO-3250-41). Dep. CFSTI.

8993 (DOCKET-50219-59) OYSTER CREEK NUCLEAR GENERATING STATION, UNIT NO. 1. Report of Abnormal Occurrence. (Jersey Central Power and Light Co., Morristown, N. J.). 3 Nov 1969. 4p. Dep. CFSTI.

8994 (DOCKET-50220-31) [NINE MILE POINT NUCLEAR STATION]. License No. DPR-17. Technical Specifications, Change No. 2. (Division of Reactor Licensing (AEC), Washington, D. C.). 12 Dec 1969. 3p. Dep. CFSTI.

For Niagara Mohawk Power Corp., Syracuse, N. Y.

Modifications in fuel cladding safety limits are presented. (D.C.C.)

8995 (DOCKET-50237-20) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Safety Analysis Report, Vol. 2. (Commonwealth Edison Co., Chicago, Ill.). 17 Nov 1967. 324p. (DOCKET-50249-20). Dep. CFSTI.

DRESDEN POWER REACTOR, UNIT 2—control systems and instrumentation for, safety analysis of
—electrical system for, safety analysis of
—radioactive waste system for, safety analysis of
—emergency and auxiliary systems for, safety analysis of
—steam and power conversion systems for, safety analysis of
—buildings for, safety analysis of
—operation of, safety analysis of proposed
DRESDEN POWER REACTOR, UNIT 3—control systems and instrumentation for, safety analysis of
—electrical system for, safety analysis of
—radioactive waste system for, safety analysis of
—emergency and auxiliary systems for, safety analysis of
—steam and power conversion systems for, safety analysis of
—buildings for, safety analysis of
—operation of, safety analysis of proposed (M.L.S.)

8996 (DOCKET-50237-22) [DRESDEN NUCLEAR POWER STATION, UNIT 2]. Plant Design and Analysis Report, Amendment 3. (Commonwealth Edison Co., Chicago, Ill.). 19 Aug 1965. 3p. Dep. CFSTI.

Revised values for calculation of off-site doses resulting from a hypothetical loss of coolant accident are tabulated for the Dresden Power Reactor, Unit 2. (M.L.S.)

8997 (DOCKET-50237-23) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Answers to AEC Questions. [Safety Analysis Report], Amendment 7 for Unit 2 and Amendment 8 for Unit 3. (Commonwealth Edison Co., Chicago, Ill.). 9 Sep 1968. 227p. (DOCKET-50249-23). Dep. CFSTI.

Design and fabrication procedures for the control rod drive stub tubes for the Dresden Power Reactors, Units 2 and 3, are described. All stainless steel materials in the reactor pressure vessel are listed with specifications, grades, conditions, and vendors for these materials. Details of the dynamic analysis of the pressure-suppression suction-header torus are given. The seismic design analyses for the piping system are described; methods for treating the valves in the analyses are discussed. Drywell shell filler material is described. Building design and Class I seismic criteria are given. The design flow control line is defined in terms of reactivity feedback. Nominal steady-state thermal margins are shown as a function of recirculation flow rate. Cladding strains associated with peak fuel exposures are described; maximum local peaking factors are given. Thermal margins are evaluated for hypothetical transients occurring at the rod block monitor point. Effects of design-load changes on reactor operation are considered. Methods for analysis of the integrity of reactor vessel internals are outlined. The capability of the ECCS to limit fuel clad temperatures to assure clad integrity is evaluated. Design and operations details are given for all parts and systems within the Emergency Core Cooling Systems. Procedures and equipment for fire protection and fire prevention are identified. Provisions for effluent monitoring and control are outlined. (M.L.S.)

8998 (DOCKET-50237-24) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Appendixes A and B. Safety Analysis Report. Errata and Addenda to Amendment 7 (Unit 2) and Amendment 8 (Unit 3). (Commonwealth Edison Co., Chicago, Ill.). 9 Sep 1968. 525p. (DOCKET-50249-24). Dep. CFSTI.

Revised and additional pages are given for all sections of the Safety Analysis Report for Dresden Power Reactor, Units 2 and 3. Appendices include stack release limit calculations and a comparison of Dresden, 2 and 3 design with the AEC General Design Criteria. (M.L.S.)

8999 (DOCKET-50237-25) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Answers to AEC Questions. [Safety Analysis Report], Amendment 9 for Unit 2 and Amendment 10 for Unit 3. (Commonwealth Edison Co., Chicago, Ill.). 28 Feb 1969. 142p. (DOCKET-50249-25). Dep. CFSTI.

Reactor stability and models used to analyze the Dresden Power Reactor, Units 2 and 3, are described; results of open-loop and closed-loop analyses are shown graphically. Details of load control for the Dresden units are given; the automatic load dispatching, turbine and recirculation flow control systems, and failure mode and effect analyses are described. Failure of the Dresden Island lock is considered. Operation of the standby liquid and gas systems is described. The design of electrical penetrations and cable runs is discussed. Detailed procedures and specifications for the environmental monitoring program are given. Operations and personnel responsibilities are described. Testing of the

emergency and ECCS systems is discussed; preoperational thermal and hydraulic tests are outlined. Startup and low power tests are summarized. (M.L.S.)

9000 (DOCKET-50237-26) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Answers to AEC Questions. [Safety Analysis Report], Amendment 10 for Unit 2 and Amendment 11 for Unit 3. (Commonwealth Edison Co., Chicago, Ill.). 18 Mar 1969. 159p. (DOCKET-50249-26). Dep. CFSTI.

Details of the analytical methods, models, and assumptions for coolant loss accident analyses are given. Core heat transfer and nature of blowdown during a coolant loss accident are described. Blowdown calculations with a new level swell model are discussed; data are shown graphically. Effects of reduction of number of safety valves from 20 to 8 on the pressure vessel and primary system are analyzed under pressure- and flux-scram transients. Revised and additional pages are also included for the following Final Safety Analysis Report (FSAR): Reactor Core; Engineered Safeguards; and Electrical System. (M.L.S.)

9001 (DOCKET-50237-27) [DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3]. Generating Stations Emergency Plan (GSEP). [Safety Analysis Report], Amendment 12 for Unit 2 and Amendment 13 for Unit 3. (Commonwealth Edison Co., Chicago, Ill.). 20 May 1969. 145p. (DOCKET-50249-27). Dep. CFSTI.

The generating stations emergency plan for the Dresden Power Reactor, Units 1, 2, and 3 is included. Authority and responsibilities are delineated and the liaison with governmental authorities is assigned. The spectrum of incidents is defined and protective action levels specified. Communications facilities, the nuclear medical plan, and recovery plans are detailed. Guidelines for public information and plant security are given. Operational readiness is described. (M.L.S.)

9002 (DOCKET-50244-27) [ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1]. [Changes in Facility Technical Specifications]. (Rochester Gas and Electric Corp., N. Y.). 31 Oct 1969. 3p. Dep. CFSTI.

Modifications in control rod actuation times are described. (D.C.C.)

9003 (DOCKET-50244-33) [ROBERT] GINNA STATION, UNIT NO. 1. Stuck Rod Incident. (Rochester Gas and Electric Corp., N. Y.). 12 Dec 1969. 2p. Dep. CFSTI.

9004 (DOCKET-50245-20) MILLSTONE NUCLEAR POWER STATION, UNIT NO. 1. Proposed Technical Specifications. Revision 1. [Preliminary Safety Analysis Report], Amendment 20. (Connecticut Light and Power Co., Hartford. Hartford Electric Light Co., Conn. Western Massachusetts Electric Co., Greenfield. Millstone Point Co., Wethersfield, Conn.). 17 Nov 1969. 160p. Dep. CFSTI.

Safety limits on fuel cladding and cooling systems are described. Engineered safeguard systems actuation sequences are listed. Protection system instrumentation requirements and inspection schedules are described. Control system limiting conditions are analyzed. Emergency core cooling system requirements and operation requirements for containment systems are described. Environmental monitoring requirements are analyzed. Emergency power system inspection and maintenance schedules are listed. (D.C.C.)

9005 (DOCKET-50245-23) MILLSTONE NUCLEAR POWER STATION, UNIT 1. [Final Safety Analysis Report], Amendment 22. (Connecticut Light and Power Co., Hartford. Hartford Electric Light Co., Conn. Western Massachusetts Electric Co., Greenfield. Millstone Point Co., Wethersfield, Conn.). 16 Dec 1969. 6p. Dep. CFSTI.

Testing procedures for the bellows failure detector system are presented. The cooling system for bearings of the emergency core cooling system motors is described. (D.C.C.)

9006 (DOCKET-50245-24) [MILLSTONE NUCLEAR POWER STATION, UNIT 1]. Preoperational Environmental Radiation Survey Program. Semi-Annual Report, April 1-September 30, 1969. (Tracerlab, Waltham, Mass.). 29 Dec 1969. 47p. Dep. CFSTI.

For Millstone Point Co., Wethersfield, Conn.

9007 (DOCKET-50247-13) [INDIAN POINT NUCLEAR GENERATING UNIT NO. 2]. [Preliminary Safety Analysis Report], Amendment 13. (Consolidated Edison Co. of New York, Inc., New York). 29 Dec 1969. 56p. Dep. CFSTI.

Load combinations for the Indian Point Power Reactor, Unit 2 primary pump motor unit are analyzed with respect to pump-component failures. Design computations for containment penetrations are detailed. Equilibrium secondary coolant activity is tabulated on an isotopic basis for a coolant activity based on 1% failed fuel. The processing of coolant water prior to holdup in the monitor tanks is described; expected activity levels for the tanks are tabulated. The reorganization of Westinghouse management for the Indian Point 2 project is detailed. (M.L.S.)

9008 (DOCKET-50250-15) TURKEY POINT PLANT, UNITS NO. 3 AND NO. 4. Final Safety Analysis Report, [Amendment 18], Suppl. 18. (Florida Power and Light Co.). 12 Nov 1969. 154p. (DOCKET-50251-15). Dep. CFSTI.

Safety limits for reactor operations are analyzed. Cooling systems inspection schedule is presented. Engineered safeguards testing programs are described. (D.C.C.)

9009 (DOCKET-50261-16) H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2. [Preliminary Safety Analysis Report], Amendment 11. (Carolina Power and Light Co., Raleigh, N. C.). 2 Dec 1969. 237p. Dep. CFSTI.

Safety requirements for the coolant pump components to prevent missile generation are described. Coolant loss test effects on fuel rods are analyzed. Radiation doses due to coolant loss accident are calculated. Meteorological characteristics of the site are presented. Shielding requirements are described. Seismic stress analysis of containment structures is presented. Reactor coolant system inspection procedures are described. Emergency power systems are also described. Engineered safeguards are analyzed. (D.C.C.)

9010 (DOCKET-50261-18) H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2. [Preliminary Safety Analysis Report], Amendment 12. (Carolina Power and Light Co., Raleigh, N. C.). 15 Dec 1969. 101p. Dep. CFSTI.

The containment structure pressure venting system is described. Engineered safeguards actuation sequences are analyzed. Stress analysis of reactor buildings is presented. Control system actuation circuits are described. Startup and operating personnel requirements are discussed. (D.C.C.)

9011 (DOCKET-50261-19) H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2. [Preliminary Safety Analysis Report], Amendment 13. (Carolina Power and Light Co., Raleigh, N. C.). 15 Dec 1969. 259p. Dep. CFSTI.

The quality assurance program is described. Containment spray and venting system design parameters are listed. Personnel qualifications and requirements are described. Emergency procedures and responsibilities for reactor personnel are listed. Safety limits for reactor operation are analyzed. Emergency power system and emergency core cooling system are described. Stress analysis of reactor buildings is presented. (D.C.C.)

9012 (DOCKET-50263-33) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Final Safety Analysis Report, Amendment 23. (Northern States Power Co., Minneapolis, Minn.). 21 Nov 1969. 214p. Dep. CFSTI.

Additional information related to the emergency core cooling system is presented. Design parameters for the emergency power systems are included. Safety limits and limiting safety system settings are presented. Surveillance procedures and requirements are described. Design parameters and personnel qualifications are listed. (D.C.C.)

9013 (DOCKET-50263-34) [MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1]. Final Safety Analysis Report, Amendment 24. (Northern States Power Co., Minneapolis, Minn.). 18 Dec 1969. 13p. Dep. CFSTI.

Revised information on the Monticello Power Reactor is given for the following Final Safety Analysis Report sections: cooling system, control system, and seismic and tornado loadings of structures. (M.L.S.)

9014 (DOCKET-50271-13) VERMONT YANKEE NUCLEAR POWER STATION. Environmental Surveillance Program. (Vermont Yankee Nuclear Power Corp., Rutland). Nov 1969. 70p. Dep. CFSTI.

The environmental monitoring program for the reactor site is described. The effects of thermal effluents on the site environment are analyzed for 1967 and 1968. (D.C.C.)

9015 (DOCKET-50271-14) VERMONT YANKEE NUCLEAR POWER STATION. Final Safety Analysis Report, Vol. 1. [Preliminary Safety Analysis Report, Amendment 10]. (Vermont Yankee Nuclear Power Corp., Rutland). 12 Jan 1970. 457p. Dep. CFSTI.

VERMONT YANKEE POWER REACTOR — site for, final safety analysis of,
— core for, final safety analysis of design for
— cooling system for, final safety analysis of design for
(M.L.S.)

9016 (DOCKET-50271-15) VERMONT YANKEE NUCLEAR POWER STATION. Final Safety Analysis Report, Vol. 2. [Preliminary Safety Analysis Report, Amendment 10]. (Vermont Yankee Nuclear Power Corp., Rutland). 12 Jan 1970. 566p. Dep. CFSTI.

VERMONT YANKEE POWER REACTOR—containment system for, final safety analysis of
—engineered safeguards for, final safety analysis of
—control systems and instrumentation for, final safety analysis of (M.L.S.)

9017 (DOCKET-50271-17) VERMONT YANKEE NUCLEAR POWER STATION. Final Safety Analysis Report, Vol. 4. [Preliminary Safety Analysis Report, Amendment 10]. (Vermont Yankee Nuclear Power Corp., Rutland). 12 Jan 1970. 324p. Dep. CFSTI.

VERMONT YANKEE POWER REACTOR—buildings at, detailed seismic analyses of
—research and development programs for
—quality assurance program for
—stack for, calculation of release limits for
—site for, results of preoperational meteorological monitoring program at (M.L.S.)

9018 (DOCKET-50285-22) FORT CALHOUN REACTOR. Pre-Operational Environmental Survey. Fourth Report, 3rd Quarter 1969. (Trapelo/West, Richmond, Calif.). 7 Nov 1969. 21p. Dep. CFSTI.

For Omaha Public Power District, Nebr.

9019 (DOCKET-50293-20) PILGRIM NUCLEAR POWER STATION. Final Safety Analysis Report, Vol. 1. [Preliminary Safety Analysis Report, Amendment 12]. (Boston Edison Co., Mass.). 12 Jan 1970. 508p. Dep. CFSTI.

PILGRIM POWER REACTOR—site for, final safety analysis of
—core for, final safety analysis of design for
—cooling system for, final safety analysis of design for
—containment systems for, final safety analysis of
—engineered safeguards for, final safety analysis of (M.L.S.)

9020 (DOCKET-50293-21) PILGRIM NUCLEAR POWER STATION. Final Safety Analysis Report, Vol. 2. [Preliminary Safety Analysis Report, Amendment 12]. (Boston Edison Co., Mass.). 12 Jan 1970. 454p. Dep. CFSTI.

PILGRIM POWER REACTOR—control systems and instrumentation for, final safety analysis of
—electrical power systems for, final safety analysis of
—radioactive waste and control systems for, final safety analysis of
—emergency and auxiliary systems for, final safety analysis of (M.L.S.)

9021 (DOCKET-50293-23) PILGRIM NUCLEAR POWER STATION. Final Safety Analysis Report, Vol. 4. [Preliminary Safety Analysis Report, Amendment 12]. (Boston Edison Co., Mass.). 12 Jan 1970. 261p. Dep. CFSTI.

PILGRIM POWER REACTOR—quality assurance program for
—operational analysis of, nuclear safety
—site for, design criteria for tornado-resistant structures at
—site for, effects of seabreezes at
—research and development program for (M.L.S.)

9022 (DOCKET-50293-24) PILGRIM NUCLEAR POWER STATION. Final Safety Analysis Report, Vol. 5. [Preliminary Safety Analysis Report, Amendment 12]. (Boston Edison Co., Mass.). 12 Jan 1970. Dep. CFSTI.

Report consists of 6 BWR Operating Charts.

PILGRIM POWER REACTOR—operation of, complete set of charts for (M.L.S.)

9023 (DOCKET-50309-18) MAINE YANKEE ATOMIC POWER STATION. Radiological Monitoring Program. (Maine Yankee Atomic Power Co., Westboro, Mass.). 10 Dec 1969. 11p. Dep. CFSTI.

9024 (DOCKET-50313-17) [ARKANSAS NUCLEAR ONE]. Preliminary Safety Analysis Report, Amendment 14. (Arkansas Power and Light Co., Little Rock). 17 Nov 1969. 92p. Dep. CFSTI.

The organization and objectives of the quality assurance program are described. Design parameters for the containment structure are included. (D.C.C.)

9025 (DOCKET-50317-16) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Nondestructive Testing Procedures for Pumps used in Safeguard Systems. (Baltimore Gas and Electric Co., Md.). 24 Nov 1969. 2p. (DOCKET-50318-16). Dep. CFSTI.

9026 (DOCKET-50320-16) THREE MILE ISLAND NUCLEAR STATION, UNIT 2. [Construction Permit No. CPPR-66 to Jersey Central Power and Light Co. and Metropolitan Edison Co.]. (Division of Reactor Licensing (AEC), Washington, D. C.). 4 Nov 1969. 14p. Dep. CFSTI.

9027 (DOCKET-50323-10) DIABLO CANYON NUCLEAR POWER PLANT, UNIT 2. Safety Evaluation by the Division of Reactor Licensing. (Pacific Gas and Electric Co., San Francisco, Calif.). 18 Nov 1969. 94p. Dep. CFSTI.

Geologic, hydrologic, and meteorologic characteristics of the reactor site are analyzed. The containment structures and engineered safeguards are described. Seismic stress analysis of Class 1 structures is presented. Emergency power systems are described. Accident conditions are analyzed. (D.C.C.)

9028 (DOCKET-50327-13) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 7. (Tennessee Valley Authority, Chattanooga. Office of Power). 12 Nov 1969. 101p. (DOCKET-50328-13). Dep. CFSTI.

Flood conditions for the reactor site are analyzed. Geologic, hydrologic, and meteorologic characteristics of the site are presented. (D.C.C.)

9029 (DOCKET-50327-14) [SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2]. [Preliminary Safety Analysis Report], Amendment 8. (Tennessee Valley Authority, Chattanooga. Office of Power). 24 Nov 1969. 375p. (DOCKET-50328-14). Dep. CFSTI.

Additional information on seismic stresses related to the reactor site is presented. Design parameters for the cooling system components are described. Coolant loss engineered safeguards are analyzed. Emergency power systems are described. Stress analysis of cooling and emergency system components is presented. (D.C.C.)

9030 (DOCKET-50331-16) DUANE ARNOLD ENERGY CENTER. Preliminary Safety Analysis Report, Amendment 10. (Iowa Electric Light and Power Co., Cedar Rapids). 26 Nov 1969. 378p. Dep. CFSTI.

Fabrication and inspection procedures for piping systems are described. Seismic stress analysis for support structures is presented. Site exploration and drilling procedures are analyzed. (D.C.C.)

9031 (DOCKET-50331-17) DUANE ARNOLD ENERGY CENTER. Preliminary Safety Analysis Report, Amendment 12. (Iowa Electric Light and Power Co., Cedar Rapids). 10 Dec 1969. 7p. Dep. CFSTI.

Instrument line penetrations in the containment structure are described. Site exploration and drilling procedures are analyzed. (D.C.C.)

9032 (DOCKET-50333-11) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Preliminary Safety Analysis Report, Amendment 8. (Power Authority of the State of New York). 5 Nov 1969. 111p. Dep. CFSTI.

Geologic, hydrologic, and meteorologic characteristics of the reactor site are presented. The radwaste system is described. Seismic stress analysis for reactor buildings and systems is presented. Qualifications and responsibilities of reactor personnel are analyzed. (D.C.C.)

9033 (DOCKET-50333-12) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Preliminary Safety Analysis Report, Amendment 9. (Power Authority of the State of New York). 2 Dec 1969. 18p. Dep. CFSTI.

Analysis of seismic stresses in support structures is presented. The effects of seismic stresses on piping systems are analyzed. (D.C.C.)

9034 (DOCKET-50333-13) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Preliminary Safety Analysis Report, Amendment 10, Suppl. 9. (Power Authority of the State of New York). 18 Dec 1969. 23p. Dep. CFSTI.

Quality assurance requirements for Class 1 equipment are described. Environmental monitoring of site boundaries under accident release conditions is analyzed. Emergency systems are described. (D.C.C.)

9035 (DOCKET-50334-10) BEAVER VALLEY POWER STATION. [Preliminary Safety Analysis Report], Amendment 8. (Duquesne Light Co., Pittsburgh, Pa.). 17 Nov 1969. 23p. Dep. CFSTI.

Emergency core cooling system requirements are described. Safety systems and activation circuits for the systems are analyzed. (D.C.C.)

9036 (DOCKET-50334-11) BEAVER VALLEY POWER STATION. Preliminary Safety Analysis Report, Amendment 9. (Duquesne Light Co., Pittsburgh, Pa.). 21 Nov 1969. 26p. Dep. CFSTI.

Emergency containment systems are described. Leakage collection and exhaust systems are illustrated. (D.C.C.)

9037 (DOCKET-50334-12) BEAVER VALLEY POWER STATION. [Preliminary Safety Analysis Report], Amendment 10. (Duquesne Light Co., Pittsburgh, Pa.). 10 Dec 1969. 229p. Dep. CFSTI.

Seismic stress analysis for the support structures is presented. Fabrication of the containment structure is described. Safety limits on reactor components are analyzed. The emergency core cooling system is described. (D.C.C.)

9038 (DOCKET-50334-13) BEAVER VALLEY POWER STATION. VOLUME 5. Preliminary Safety Analysis Report, Amendment 11. (Duquesne Light Co., Pittsburgh, Pa.). 17 Dec 1969. 473p. Dep. CFSTI.

Additional information related to geologic, hydrologic, and meteorologic characteristics of the reactor site is presented. Reactor support structures are described. Flow diagrams for reactor cooling systems, engineered safeguards, containment systems, and emergency core cooling systems are included. (D.C.C.)

9039 (DOCKET-50335-10) HUTCHINSON ISLAND PLANT, UNIT NO. 1. Preliminary Safety Analysis Report, Amendment 5. (Florida Power and Light Co.). 4 Dec 1969. 197p. Dep. CFSTI.

The quality assurance program is described. Seismic stress requirements for reactor buildings and components are listed. Emergency power systems are described. Operating safety limits are analyzed. Inspection schedules for cooling system components are included. Engineered safeguards are described. (D.C.C.)

9040 (DOCKET-50336-6) MILLSTONE NUCLEAR POWER STATION, UNIT NO. 2. Preliminary Safety Analysis Report, Amendment 2. (Connecticut Light and Power Co., Hartford. Hartford Electric Light Co., Conn. Western Massachusetts Electric Co., Greenfield. Millstone Point Co., Wethersfield, Conn.). 4 Dec 1969. 132p. Dep. CFSTI.

Additional information is presented under the following headings: General; Site Radwaste and Accident Analysis; Reactor and Reactor Coolant System; Structural Design; Emergency Systems; Instrumentation, Control, and Electrical Power; and Auxiliary Systems. (D.C.C.)

9041 (DOCKET-50338-9) NORTH ANNA POWER STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 3. (Virginia Electric and Power Co., Richmond). 10 Nov 1969. 158p. (DOCKET-50339-9). Dep. CFSTI.

Design parameters of the cooling system components are presented. Emergency injection systems are described. Instrumentation requirements for the engineered safeguards are presented. Design parameters of the emergency core cooling system are listed. Personnel responsibilities are analyzed. Analysis of Design Basis Accident conditions is presented. Seismic stress requirements of buildings are included. The quality assurance program is described. (D.C.C.)

9042 (DOCKET-50341-7) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Preliminary Safety Analysis Report, Amendment 1. (Detroit Edison Co., Mich.). 2 Dec 1969. 63p. Dep. CFSTI.

The quality assurance program is described. Purchasing and inspecting procedures are discussed. (D.C.C.)

9043 (DOCKET-50344-6) [TROJAN NUCLEAR PLANT]. Preliminary Safety Analysis Report, Amendment 3. (Portland General Electric Co., Oreg.). 13 Nov 1969. 93p. Dep. CFSTI.

Personnel qualifications are listed. The quality assurance program is described. (D.C.C.)

9044 (DOCKET-50346-5) DAVIS-BESSE NUCLEAR POWER STATION. Preliminary Safety Analysis Report, Amendment 1. (Toledo Edison Co., Ohio). 15 Dec 1969. 240p. Dep. CFSTI.

Design parameters for reactor buildings are described. Analysis of earthpulse hazards is presented. Geologic characteristics of the reactor site are analyzed. The emergency core cooling system and engineered safeguard systems are described. Emergency power and waste disposal systems are also described. (D.C.C.)

9045 (EUR-4392) LATINA NUCLEAR POWER PLANT. Annual Report, 1968. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). 29 Sep 1969. 48p. (In Italian). Dep. CFSTI (U. S. Sales Only).

The power plant operated normally during 1968. A utilization factor of 83.7% and an availability factor of 86.0% were achieved. There were no long shutdowns worth mentioning apart from the period June 1 through 23 when routine general maintenance was carried out. This shut-down lasted 13 days longer than the scheduled ten days owing to additional maintenance work required on the No. 4 main coolant circuit inlet valve. The unavailability for nuclear reasons was due in particular to damage to the charge chute, which kept the power plant shut down for four days. Among the conventional causes of non-availability should be mentioned the failure of the turbine main oil pump, which was out of service for about twelve days. The routine maintenance during the period June 1-23 concerned various reactor components (boilers 1-2-6; blowers 1-2-6; No. 4 main coolant circuit valve) and thermoelectric plant components (turbines 1-2-3-4-5; auxiliary condenser). The continuous unloading of fuel was carried on up to the end of May, by which date the total unloaded was seven tonnes ahead of the theoretical cycle. The cycle was suspended in June for the routine annual maintenance period. At the end of August the actual quantity unloaded was equal to the theoretical estimate. In all, 81.3 tonnes of fuel were unloaded in the course of the year. As regards fuel behavior, there was some increase of cladding failures among low-burnup elements in position 4. The reasons for these failures, which metallographic examination revealed to be intracrystalline fractures caused by grain growth, are being investigated. (auth)

9046 (EUR-4393) GARIGLIANO NUCLEAR POWER PLANT. Annual Report, 1968. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). 29 Sep 1969. 112p. (In Italian). Dep. CFSTI (U. S. Sales Only).

The working period March 1, 1968-February 28, 1969 is summarized. During that period the Garigliano plant operated with an average utilization factor of 73.3% and generated a total electricity output of 1,028 million kWh. On July 30, 1968, the close of the 1-C cycle, the plant was shut down and was out of service until October 10, 1968, the start of cycle 2, for general servicing and modifications to certain plant components and for refueling of the reactor with 54 fresh and 18 part-irradiated U elements, together with twelve prototype Pu elements comprising eight of standard and four of advanced type. On February 28, 1969 the average core burnup was 7,900 MWd/t of U while the maximum element burnup had reached 14,600 MWd/t. During cycle 1-C there were thirteen shutdowns, with a total outage of 757 hours. Leakages in the feed water preheaters caused six shutdowns totalling 576 hours; three shutdowns, for 134 hours, were caused by the turboset and the main transformer; and lastly, two shutdowns, for 28 hours, were required to stop leaks in the turbine bleed and drain lines. There were also two spurious reactor scrams due to the reactor HP pressure switches (9 hours) and a grid disturbance (9 hours). The core power efficiency at the end of cycle 1-C was 11,000 MWd/t. The replacement of the Cu alloy preheaters by stainless steel units during the schedules shutdown substantially altered the chemistry of the primary circuit. The levels of products in suspension fell to extremely low values (practically zero for Cu and Ni). As to the corrosion products in suspension, the Cu values remained virtually unchanged, but Ni and Fe dropped to extremely low concentrations. (auth)

9047 (EUR-4396) GUNDREMMINGEN (KRB) NUCLEAR POWER PLANT. Annual Report, 1968. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). 3 Oct 1969. 54p. (In German). Dep. CFSTI (U. S. Sales Only).

The availability of the plant as a whole was adversely affected by multiple damage to the low-pressure casing. Inspections carried out during operation of the turbine with the blocking of the low pressure casing removed revealed the cause of the damage; the necessary modifications and repairs are scheduled for the summer of 1969. The behavior of the reactor and its auxiliaries was in accordance with expectations. Despite defective fuel elements the amounts of activity released into the environment with the exhaust air and waste water remained well below the permissible values. (auth)

9048 (EUR-4397) LINGEN NUCLEAR POWER PLANT. Annual Report, 1968. (Kernkraftwerk Lingen G.m.b.H. (West Germany)). 3 Oct 1969. 52p. (In German). Dep. CFSTI (U. S. Sales Only).

On 1 October 1968 the Lingen nuclear power plant was handed over to the operator by the contractors after a construction period lasting four years, including start-up and trial operation. The first nine months of 1968 were marked by the start-up and trial

operation of the plant. On 31 January the reactor went critical for the first time. The first electricity was supplied to the grid of the Vereinigte Elektrizitätswerke Westfalen AG (VEW) on 20 May, full capacity of 252 MW(e) being reached on 20 July. The tests proved satisfactory. Since it was taken over, the plant has been operated in line with the plan laid down by the VEW load despatcher. The availability versus load demand was 96.3% during the last quarter of 1968, and the total utilization factor—referred to the installed capacity—an average of 75%. A description is given of startup and operation. The radiological, chemical and physical data relating to the plant are included. Information is also given on the contracts drawn up in 1968 and on the financing. (auth)

9049 HARTLEPOOL AGR: BUILDING LAYOUT. Bottrill, C.; Veal, A. R. (British Nuclear Design and Construction, London). Nucl. Eng. Int., 14: 991-4(Nov 1969).

A close study of construction methods and attention to layout resulted in the major part of the plant being installed in a single building complex, and in overall savings in capital cost. Descriptions are given of the construction and layout of the reactor halls and pressure vessel, the fuel handling block, service buildings, and the turbine house. Support of the reactor hall structure by a series of slip-forming towers made it possible for an overhead internal crane to be used early in the construction, prior to its use in moving heavy components into the reactor. (UK)

9050 HARTLEPOOL AGR REACTOR PRESSURE VESSEL. Burrows, R. E. D. (Taylor Woodrow Construction, Southall, Eng.); Williams, A. J. Nucl. Eng. Int.; 14: 973-9(Nov 1969).

The cylindrical prestressed concrete pressure vessel contains the boilers fitted as works assembled and tested units into pods in the walls of the vessel. The advantages of the system are discussed. Details are given of the liner, penetrations, and the hot-box dome. Methods of stress analysis are outlined. The prestressing systems include the use of concentrated bands of wire wound under tension into channels preformed in the vessel walls. The insulation and cooling pipework are described. (UK)

9051 HARTLEPOOL AGR. Nucl. Eng. Int.; 14: 980 (Nov 1969).

A large pull-out chart showing a coloured sectional drawing of the reactor is presented. Main parameters are listed. (UK)

9052 HARTLEPOOL AGR: CORE AND REFUELLING SYSTEM. Tyrrell, J. F.; Walker, A. (British Nuclear Design Corp., London). Nucl. Eng. Int.; 14: 980-2(Nov 1969).

The arrangement of the graphite stack and core support structures is described. New design features include keying of the restraint structure to the pressure vessel, and a bottom neutron shield which forms an integral part of the stack. Details are given of the three-tube standpipe and the guide tubes. Advantages of the fueling system, which is based on single channel access with lattice fuel channels and interstitial control rod channels, are considered. (UK)

9053 HARTLEPOOL AGR: MAIN AND ESSENTIAL ELECTRICAL SYSTEMS. Thornton, D. J.; Jebson, P. (British Nuclear Design and Construction, London). Nucl. Eng. Int.; 14: 985-8(Nov 1969).

Simplification in the design of the emergency power system has resulted in reduction in plant size. The use of generator circuit breakers to connect and disconnect the main generators at terminal voltage eliminates the need for station transformers and associated switch gear, and also offers a number of safety features. Four gas turbo alternator units provide emergency power to essential auxiliaries. Much of the cabling design work is computer assisted. (UK)

9054 HARTLEPOOL AGR: POD BOILERS. George, B. V. (British Nuclear Design and Construction, London). Nucl. Eng. Int.; 14: 983-4(Nov 1969).

The boilers are arranged in eight vertical pods in the walls of the prestressed concrete pressure vessel. The advantages of the system are listed. Details are given of the design of the boilers and of the design and operation of the start-up system, which is similar to that used in conventional once-through boilers. Reference is made to the research and development work relating to the use of helically coiled tubes in the pod boilers. (UK)

9055 HARTLEPOOL AGR: COMPUTER CONTROL APPLICATIONS. Welbourn, D.; Graham, G. V. (British Nuclear Development Corp., London). Nucl. Eng. Int.; 14: 988-90(Nov 1969).

The comprehensive use of data processing equipment to control the reactor from start-up to full power is described. Extensive use is made of computers for the main station closed loop control. Advantages of the system are discussed. (UK)

9056 HARTLEPOOL AGR: CIVIL ENGINEERING ASPECTS. Lakin, N. O. E.; Morris, D. A. (Taylor Woodrow Construction, Southall, Eng.). Nucl. Eng. Int.; 14: 994-5(Nov 1969).

The ground conditions and the excavation work carried out in preparing the foundations are described. The superstructure and substructure of the reactor building are described. The design of the reactor halls is based on the use of six reinforced concrete towers rapidly constructed by the slip form method. The circulating water system for cooling the turbine condensers is also described. (UK)

9057 FORT ST. VRAIN: INSTRUMENTATION AND CONTROL. Haake, E. V. Nucl. Eng. Int.; 14: 1078-82(Dec 1969).

The three major systems described are: the plant control system, controlling operation of the steam generators and the reactor; the protective system, which provides automatic protection and corrective action in abnormal situations; and monitoring instrumentation for measurement of neutron flux, He moisture, He impurity and activity, and radiation protection. The protective actions described include termination of control rod withdrawals, reactor scram, loop shutdown, circulator trip, steam—water dump, and steam generator depressurization. (UK)

9058 FORT ST. VRAIN: PRESTRESSED CONCRETE REACTOR PRESSURE VESSEL. Northup, T. E.; Peinado, C. Nucl. Eng. Int.; 14: 1082-5(Dec 1969).

Details are given of the design requirements and stress analysis of the prestressed concrete pressure vessel. The arrangement of the prestressing system is described and illustrated. Descriptions are also given of the penetration liners and the arrangement of the main liner, with its thermal insulation and cooling system. Brief reference is made to the type of concrete, the bonded reinforcing steel for controlling cracks, and to proof testing. (UK)

9059 FORT ST. VRAIN: CORE DESIGN CHARACTERISTICS. Dahlberg, R. C.; Turner, R. F.; Goeddel, W. V. Nucl. Eng. Int.; 14: 1073-7(Dec 1969).

The core, which evolved from that of Peach Bottom, consists of a shorter and bulkier hexagonal graphite block through which He coolant flows through vertical cylindrical holes. Fission product control is achieved by pyrolytic C and SiC coatings on kernels of U and ThC_2. Details are presented of the core, graphite and fuel particles. The fuel cycle is examined. Fuel performance is discussed and results are given of irradiation tests on the fuel. (UK)

9060 THE WORLD'S REACTOR, NO. 48: FORT SAINT VRAIN. Nucl. Eng. Int.; 14: 1076(Dec 1969).

A pull-out sheet shows a large cut-away sectional drawing of the reactor, in colour. The main parameters are listed. (UK)

9061 FORT ST. VRAIN: CONSTRUCTION AND SITE WORK. Habush, A. L. Nucl. Eng. Int.; 14: 1090-3(Dec 1969).

To comply with earthquake design criteria, the reactor building is founded directly on bedrock. A description is given of the excavation work and of the freeze wall method of providing a cofferdam. Details are given of the various stages in the erection of the concrete pressure vessel and the turbine hall. (UK)

9062 FORT ST. VRAIN: NUCLEAR COMPONENTS. Davis, D. E.; Krase, J. M. Nucl. Eng. Int.; 14: 1085-90 (Dec 1969).

The station has two primary coolant loops, each containing two He-loops and a once-through steam generator which consists of six modules with integral superheater and reheater. Descriptions are given of the steam generators and of the axial flow He compressors which are steam turbine driven. The control and orifice assembly, which performs all functions for control of the fission process and coolant flow distribution under normal and emergency conditions, and for emergency shutdown, is described. Full details are given of the off load fuel-handling equipment. (UK)

9063 FORT SAINT VRAIN NUCLEAR POWER STATION. Walker, R. E.; Johnson, T. A. Nucl. Eng. Int.; 14: 1069-77 (Dec 1969).

The HTGR station, under construction in Colorado, incorporates a number of new design features. A simplified flow diagram is presented and main parameters are listed. Descriptions are given of the following: the prestressed concrete pressure vessel which contains all major components of the nuclear supply system; the hexagonal shaped graphite fuel elements incorporating carbon coated uranium-thorium carbide fuel; the He circulators and the He purification system; the once through modular steam generators with integral superheaters and reheaters; and the turbine plant. (UK)

9064 ACTUAL SITUATION WITH THE LIGHT WATER REACTORS. Mataix, M. Energ. Nucl. (Madrid); 12: 559-70(Nov-Dec 1968). (In Spanish).

A survey of world situation with respect to installed nuclear power capacity is given. The light water power reactors of the world are tabulated. General discussions of systems and components are given for both BWRs and PWRs. The results of experience with zircaloy-clad UO_2 fuels are tabulated for both types of light water reactors. (M.L.S.)

9065 COSTS OF QUALITY IN NUCLEAR ENGINEERING. Heal, T. J. Energ. Nucl. (Madrid); 12: 593-7(Nov-Dec 1969). (In Spanish).

The costs of quality assurance for plant construction and component fabrication for nuclear power plants is discussed. Programs implemented by the UKAEA are described. Effects and costs of these programs are discussed. (M.L.S.)

9066 NON-DESTRUCTIVE TESTING USED ON COMPONENTS OF THE DODEWAARD NUCLEAR POWER PLANT, ESPECIALLY THE REACTOR VESSEL. van der Meer, J.; de Jong, J. J. R. (Gemeenschappelijke Kernenergiecentrale Nederland, Arnhem). Lastechniek; 34: 139-43(May 1968). (In Dutch).

After a review of the non-destructive test methods for welds used in the construction of the power plant, the ultrasonic test methods used on the reactor vessel are described in some detail. (tr-auth)

9067 PIPING SYSTEM OF THE DODEWAARD NUCLEAR POWER PLANT. Boesjes, J.; Kramer, M.; Smeets, C. J. C.; Steynis, C. (Werkspoor, Amsterdam). Lastechniek; 34: 129-31(May 1968). (In Dutch).

The operating temperature of the Dodewaard Reactor is at 300°C with pressures from 1 to 160 atm. The three materials used are the stainless steel X5 Cr Ni Mo 18.10 and the steels 15 Mo 3 and St. 35.8/III in ASTM A106 grade B. The most significant problems in the production of the pipe system are briefly indicated. The welding procedures and the weld tests used are described. (J.S.R.)

9068 THE STORAGE WELL AT DODEWAARD. Hoek, G. (Leidsche Apparatenfabriek, Leiden). Lastechniek; 34: 127-9 (May 1968). (In Dutch).

The fuel element storage well at Dodewaard is filled with demineralized water and all its components are covered with stainless steel. The construction of the bottom, walls, and cover of the well are described. (J.S.R.)

9069 FABRICATION OF FUEL ELEMENTS FOR THE DODEWAARD POWER REACTOR. Vermeulen, J. A. C. Lastechniek; 34: 125-6(May 1968). (In Dutch).

The fuel elements of the Dodewaard Reactor are composed of bundles of fuel element tubes filled with UO_2 pellets. The cladding material is Zircaloy-2. The assembly of the fuel elements is described with emphasis on some factors which affect the weld quality and the percentage of burst tubes. (J.S.R.)

9070 THE FABRICATION OF THE REACTOR VESSEL FOR THE DODEWAARD POWER REACTOR. Verzijbergh, C. J. (Rotterdamsche Droogdok Maatschappij, Rotterdam). Lastechniek; 34: 109-17(May 1968). (In Dutch).

After a brief description of the Dodewaard Reactor and the composition of the reactor vessel, the fabrication process is described in detail. The emphasis is on the forging and heat treatment of large seamless rings, lining of the vessel with stainless steel, welding of round seams, and welding of tubes in the pressure vessel. (J.S.R.)

9071 SOME ASPECTS OF THE CONSTRUCTION OF THE CONTAINMENT SYSTEM VESSEL OF THE DODEWAARD NUCLEAR POWER STATION. Westerweele, W. M.; Nederveen, C.; Boesjes, J. (Werkspoor, Utrecht). Lastechniek; 34: 95-102 (May 1968). (In Dutch).

The containment system consists of two segmented pressure vessels and the reactor chamber. Problems connected with the calculation of the strength of the pressure vessels are outlined. The manufacture of the vessel segments is described. Welding studies made on the LQmc 52 material from which the vessel is constructed are reported. (J.S.R.)

9072 GENERAL INTRODUCTION TO THE CONSTRUCTION OF THE FIRST NETHERLANDS NUCLEAR POWER PLANT AT DODEWAARD. Wassenaar, K. (Gemeenschappelijke Kernenergiecentrale Nederland, Arnhem). Lastechniek; 34: 87-94(May 1968). (In Dutch).

A historical review of the reasons leading to selection of the site at Dodewaard and the power of 50 MW(e) is given. The nuclear power plant complex is described. The most important technical data of the installation are tabulated. (tr-auth)

9073 SOME GENERAL AND PHYSICAL ASPECTS OF THE DODEWAARD NUCLEAR POWER PLANT. Mostert, P. (Gemeenschappelijke Kernenergiecentrale Nederland, Arnhem). Lastechniek; 34: 82-6(May 1968). (In Dutch).

The Dodewaard power plant utilizes a boiling water reactor. The characteristics of the reactor are discussed and the arrangement of the fuel elements are shown graphically. The primary cooling circuit is described. (J.S.R.)

9074 CONTAINMENT SYSTEM. Wassenaar, K.; Rooij, H. M. (Gemeenschappelijke Kernenergiecentrale Nederland, Arnhem). Lastechniek; 34: 103-9(May 1968). (In Dutch).

The design background together with construction details and fabrication requirements of the containment system of the Dodewaard reactor are described in detail. Special construction and weld compounds are explained. A few facets of the assembly are also described, emphasizing the high requirements placed on the intelligence and competence of the welders. (tr-auth)

9075 INTRODUCTION TO PAPERS ON CONTROL RODS, FUEL ELEMENTS, FUEL ELEMENT STORAGE WELLS, AND PIPING SYSTEMS. Wassenaar, K. (Gemeenschappelijke Kernenergiecentrale Nederland, Arnhem). Lastechniek; 34: 118-22(May 1968). (In Dutch).

The Dodewaard Reactor core with its support construction and control rods are described and illustrated. The fuel element storage well and the high pressure steam cutoff valve are also considered. (J.S.R.)

9076 THE AUTOMATIC TIG (ARGON ARC) WELD FOR STAINLESS STEEL END CAPS IN THE POISON RODS. Schuitema, D.; Meijer, F. A. Th. Lastechniek; 34: 123-5(May 1968). (In Dutch).

The welding current characteristics of the TIG weld are described for mechanically and electronically controlled current flow. The three phases of the welding operation—the start, the welding itself, and the cut-off—for stainless steel end caps in the Dodewaard Reactor poison rods are outlined in some detail. (J.S.R.)

Power Reactor Development

Refer also to abstracts 7566, 7692, 8057, 8077, and 8108–8111.

9077 (ANL-7632) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, OCTOBER 1969. (Argonne National Lab., Ill.). 25 Nov 1969. Contract W-31-109-eng-38. 144p. Dep. CFSTI.

Highlights of project activities are summarized for the month of October 1969. LMFBR physics measurements and ZPR-3, ZPR-6, ZPR-9, and ZPPR operations during October are reviewed. Fuel and components development programs for the LMFBR are described. Research and development programs in the EBR-2 are reviewed. Nuclear safety studies, including TREAT operations, and chemical separation activities are discussed. (D.C.C.)

9078 (JUL-600-RG) POSSIBLE DEVELOPMENT OF A FUTURE ATOMIC INDUSTRY IN THE FEDERAL REPUBLIC OF GERMANY. Kraemer, H.; Seetzen, J. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung. Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Jun 1969. 53p. (In German). (KFK-933). Dep. CFSTI (U. S. Sales Only).

The future of nuclear energy in the Federal Republic of Germany is analyzed. The projected power grid allows the addition of several nuclear plants to the conventional installations. Two directions in reactor development are suggested. The first one concerns the gas-cooled line evolving from high temperature with steam turbines through HTR with He turbines to gas-cooled fast breeder reactors. The second direction, involving liquid cooling, starts with the Na breeder reactor and leads to the molten salt breeder reactor. Fuel requirements and cost considerations are almost equal for fast breeder reactors cooled by either Na or He. Therefore, both lines of development should be supported. (H.B.G.)

9079 (NP-18052) ANNUAL SCIENTIFIC REPORT, 1968. Billiau, R.; Buyse, L.; Fredrix, H. (eds.) (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). 177p. (D-68/69). Dep. CFSTI (U. S. Sales Only).

ACTINIUM ISOTOPES Ac-227—production of, 1968 Belgian activities on
BELGIAN REACTOR-1—operations experience during 1968
BELGIAN REACTOR-2—operations experience during 1968
BELGIAN REACTOR-3—operations experience during 1968
BELGIUM—nuclear energy research activities during 1968

FLUORIDE VOLATILITY PROCESSES—development in Belgium during 1968
GAMMA RADIATION—applications of, 1968 Belgian activities on
NUCLEAR PHYSICS—research activities in Belgium during 1968
RADIOACTIVE WASTE—processing of, 1968 Belgian activities in
RADIOBIOLOGY—research activities in Belgium during 1968
RADIOISOTOPES—production of, 1968 Belgium activities on
REACTOR FUELS—development in Belgium during 1968
—reprocessing by fluoride Volatility Process, 1968 Belgian activities on
REACTORS, FAST—development in Belgium during 1968
REACTORS, POWER—development in Belgium during 1968
REACTORS, THERMAL—development in Belgium during 1968
SAFETY—research on nuclear, 1968 Belgian activities in
SOLID STATE PHYSICS—research activities in Belgium during 1968 (H.D.R.)

9080 (ORNL–4459, pp 85–115) REACTOR INSTRUMENTATION AND CONTROLS. (Oak Ridge National Lab., Tenn.).
REACTOR CONTROL SYSTEMS—development at ORNL, Sept. 1968–Aug. 1969, summary of
REACTORS—instrumentation for, summary of development at ORNL, Sept. 1968–Aug. 1969
—control systems for, summary of development at ORNL, Sept. 1968–Aug. 1969 (D.C.C.)

9081 (WAPD–320) PWR CORE 1 COMPONENT EXAMINATION PROGRAM SUMMARY REPORT. Fiorelli, A. J.; Santore, C. (eds.) (Bettis Atomic Power Lab., Pittsburgh, Pa.). Oct 1969. Contract AT(11-1)-Gen-14. 143p. Dep. CFSTI.

The results of the PWR Core 1 component examination program performed on representative reactor components to obtain information which could be applied to future reactor designs are summarized. The components examined included fuel assemblies, core structural parts, control rods, control rod drive mechanisms, vessel head, core instrumentation, primary coolant piping, and steam generators. Tests and examinations provided irradiated materials data and data permitting the determination of the effects of service in the reactor, the evaluation of performance in service, as well as the determination of fuel depletions and the effects of in-plant decontamination at the end of Core 1 life. This examination program revealed there were no major deficiencies in reactor design, materials application, or structural adequacy. (auth)

9082 HIGH TEMPERATURE REACTOR WITH HELIUM TURBINE IN CONVENTIONAL, INTEGRATED MODULE, AND INTEGRATED DESIGN. Bammert, K.; Boehm, E. Energ. Tech., 21: 1–6(Jan. 1969). (In German).

The characteristic of the high temperature reactor systems which are discussed is the use of a single-phase turboset. It is shown that this permits completely integrated design and very high power levels. The emergency cooling and reheating outlet is controlled by two chambers independent of each other and the pertinent coolant. As with the turbines, the heat transfer apparatus can be conventional in all designs and can be designed with small temperature differentials and low pressure loss for ruptures of 5 to 6 m in the reinforced concrete vessel. In addition to questions of design and development, safety, maintenance, and assembly play a special role. The integrated designs are evaluated from the safety viewpoint since the total circuit is surrounded by one pressure vessel. The compact design requires extensively maintenance-free components and remote-controlled equipment. In conventional and in partially integrated designs these problems are handled more simply because of the better accessibility. As is shown, the type of design strongly affects the size of the complete structure. The constructed volume in conventional, partially integrated, and completely integrated designs has the ratio of about 3:2:1. The completely integrated design leads to a sharp reduction of the building size; its realization requires, however, a longer development time. (TSS)

9083 DONNEES ET CALCULS ECONOMIQUES DE L'ENERGIE NUCLEAIRE. CONFERENCES FAITES A L'INSTITUT NATIONAL DES SCIENCES ET TECHNIQUES NUCLEAIRES. (Economic Data and Calculations on Nuclear Energy. Lectures Presented at the National Institute of Science and Nuclear Techniques). Gaussens, Jacques (ed.). Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de Fra France, 1968. 487p.

Seven lectures presented on different aspects of economic data and calculations are compiled. The market for natural U and Th, the economic aspects of the preparation of nuclear fuels, the economic aspects of the loss of nuclear material, and the transport of new nuclear fuels are first considered. The general aspect of the problem of the minimum cost criteria is considered from two points of view: the general aspect of the problem and the criteria of minimum cost and in a second part the economic parameters intervening in the definition of a nuclear power plant program other than costs. The components of the cost per kwh of nuclear power plants are the investment costs and the fuel cycle cost; each is discussed. The economy of Pu and enriched U is then discussed. Three applications of nuclear energy other than the production of electricity, are discussed: economic aspects of nuclear marine propulsion, dual-purpose nuclear power plants producing both electricity and heat, and economic consideration on nuclear explosives. Numerical data on the present and future state of nuclear energy are tabulated. The elements of a general economic vocabulary are defined. (J.S.R.)

9084 STATE OF DEVELOPMENT AND ECONOMIC PROSPECTS OF HIGH-TEMPERATURE REACTORS. Cautius, W. (Geschaeftsfuehrer der Arbeitsgemeinschaft Versuchsreaktor GmbH, Duesseldorf, Ger.). Mitt. Ver. Grosskesselbestizer, 48: 269–78(Aug. 1968). (In German).

The present state of development and economic prospects of thermal high-temperature reactors are outlined. The high temperature reactors are characterized by the use of graphite as moderator, He as coolant, and coated particles as fuel. The advantages of high temperature reactors are outlined. The construction of high temperature reactors is illustrated by a description of the construction of the AVR reactor. The characteristics of the reactor core and the steam generator are given. The current overall plant construction costs and operation, maintenance, and fuel cycle costs are estimated for a 600 Mw high temperature reactor. (J.S.R.)

Kinetics and Dynamics

Refer also to abstract 9162.

9085 (AEEW-M–924) RESIDUAL DISTRIBUTIONS OF EXPERIMENTAL DYNAMIC RESPONSES MEASURED ON THE HTGC DRAGON REACTOR. Cummins, J. D. (Atomic Energy Establishment, Winfrith (England)). Dec 1968. 23p. Dep. CFSTI (U. S. Sales Only).

The distribution of residuals assumed in regression analysis by least squares fitting techniques is considered. The actual distributions of residuals obtained for some of the HTGC Dragon reactor optimization studies are presented and it is shown that the frequency spectrum of the residuals may be considered either (a) as white noise or (b) as white noise passed through a filter of time constant approximately 10 seconds. (auth) (UK)

Control Systems

9086 (DOCKET-50018–10) VALLECITOS BOILING WATER REACTOR. Mechanical Stops Being Installed on Control Rods. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 19 Apr 1962. 18p. Dep. CFSTI.

A schedule for and description of proposed modifications to the VBWR control rod system are presented. The design features and methods of operation of the control rod drives and stop system being used are described. The reactivity situation with regard to stuck-rod considerations is discussed, and the relative merits of the various alternative modifications are assessed. (H.D.R.)

9087 (DOCKET-50183–2) [ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR (EVESR)]. Twin Screw Control Rod Drive Operating Experience. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 15 Dec 1962. 14p. (APED–4147). Dep. CFSTI.

The testing and operating experience with twin-screw type control rod drives is summarized. The design and performance characteristics of 5 drive models and the development of pneumatic scram valves are discussed. (H.D.R.)

9088 (DOCKET-50183–3) ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR. Twin Screw Control Rod Drive: Engineering Test. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 21 Dec 1962. 44p. (APED–4149). Dep. CFSTI.

The results of a series of tests on the performance of the drive shaft seal system, the electric-motor-driven twin-screw actuated rod positioning system, and the pneumatic scram system are presented. The expected life of drive components and component performance characteristics is established. (H.D.R.)

9089 (DOCKET-50183-4) ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR. Auxiliary Scram Rod Drive: Engineering Test. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 21 Dec 1962. 12p. (APED-4150). Dep. CFSTI.

The results of a series of tests to establish the reliability of the auxiliary drive mechanism for scram service are presented. The drive cycling tests were used to establish the expected life of drive components and to establish component performance characteristics. (H.D.R.)

9090 (DOCKET-50183-8) VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR. [Preliminary Safety Analysis Report], Amendment 4. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 1 May 1961. 23p. Dep. CFSTI.

Additional information regarding the control rod drive design and operation and the physics calculational model is presented. (H.D.R.)

9091 (DOCKET-50183-9) ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR (EVESR). [Final Hazards Summary Report], Amendment 6. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 21 Dec 1962. 3p. Dep. CFSTI.

Supplementary information concerning the reactor control rod drives is presented. (H.D.R.)

Cooling Systems

Refer also to abstracts 7701 and 8058.

9092 (KFK-1020) BOILING OF THE COOLANT IN SODIUM-COOLED FAST REACTORS. Schlechtendahl, E. G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Jun 1969. 127p. (In German). (EUR-4302). Dep. CFSTI (U. S. Sales Only).

Boiling of sodium is studied both theoretically and experimentally and the results are presented. A mathematical model for boiling processes in cylindrical cooling channels of reactor cores is developed and programmed for computer analysis. The model is not only applicable to single bubble formation but also to steam configurations involving an entire fuel element, oscillation processes between boiling and condensation, and complete condensation of bubbles with the resulting pressure impulses. The model was tested with boiling water and Na. With water, the agreement between theoretical and experimental results is excellent; with Na, the agreement is a qualitative one. Properties of Na, responsible for the observed minor deviations, are discussed. Statistical analysis shows that boiling of the coolant in a Na-cooled fast reactor does not endanger its operation. (H.B.G.)

9093 (NP-18060) SIMULATION EXPERIMENTS FOR FEEDBACK AND RECONDENSATION PROCESSES IN Na 2 FUEL ELEMENTS. Fette, P. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Jul 1969. 17p. (In German). Dep. CFSTI (U. S. Sales Only).

Disturbances in the coolant supply in Na-cooled fast breeder reactors can result in overheating and vaporization of the coolant in the affected fuel elements. The hypothetical maximum force from a collision of two fluid columns in the center of a fuel element as the result of condensation of vaporized coolant is examined both experimentally and theoretically. The experimental apparatus and procedures used are described, and results of the simulations are presented. (H.B.G.)

9094 (ORNL-TM-2791) FISSION-PRODUCT MONITORING IN HIGH-TEMPERATURE GAS-COOLED REACTORS. Baumann, C. D. (Oak Ridge National Lab., Tenn.). Dec 1969. Contract W-7405-eng-26. 43p. Dep. CFSTI.

An instrumentation system capable of identifying and measuring the accumulation of fission products in high-temperature gas-cooled reactor (HTGR) coolant loop circuits and loop components is under development. The applicability of ionization chambers, beta and gamma spectrometers, charged-wire precipitators, Čerenkov detectors, filters, diffusion tubes, thermal gradient tubes, deposition tubes, and impactors as plateout monitors is discussed. It is recommended that the deposition-tube and gamma-spectrometer systems be further developed as component plateout monitors and tested first in a high-temperature gas loop and then in reactor service. (auth)

9095 MATRA: A DIGITAL PROGRAM TO STUDY THE HYDRODYNAMIC CONDITIONS IN A BOILING CHANNEL DURING FAST TRANSIENTS. Calicchio, L.; Muscettola, M. (Laboratori CISE, Milan). Energ. Nucl. (Milan); 16: 633-40(Oct 1969).

In connection with safety studies for a CIRENE type reactor, the digital program MATRA has been written to simulate the voiding, following an accident, of a constant area channel, either heated or adiabatic, in which a steam-water mixture flows (subcooled water may be present in the initial part of the channel). A partially simplified model has been used for the non-stationary hydrodynamics of a two-phase flow, based on mass and energy conservation equations. The resulting system of quasi-linear partial differential equations has been integrated by using the method of the characteristic curves. The comparison with experimental measurements showed a good agreement between the measured and computed coolant mass contents during the transient. The program is written in FORTRAN IV for UNIVAC 1108 (with minor modifications, it can be run on IBM 7040). 3 references. (auth)

9096 AN EXPERIMENTAL INVESTIGATION ON VOIDING OF POWER CHANNELS COOLED BY STEAM-WATER MIXTURES. Premoli, A. (Laboratori CISE, Milan). Energ. Nucl. (Milan); 16: 625-32(Oct 1969).

An investigation is described concerning density transients of steam-water mixtures flowing in a heated channel as a consequence of large and fast changes in operating conditions such as pressure, flowrate and power input in the channel. The study is in connection with the accident evaluation of pressure tube reactors cooled by steam-water mixtures. The experiments have been performed with an experimental facility simulating, at a reduced scale, the cooling circuit of a pressure tube reactor: pressures, temperatures, flowrate and the most important quantity, which is the overall mass content or the average density of heated channel, were measured during the transients. Depressurization effects following ruptures upstream and downstream of the powered channel have been investigated in a wide range of experimental conditions: pressures up to 60 kg/cm^2, specific mass flowrate up to 260 g/cm^{2}s, and channel power density up to 300 W/cm^3. Preliminary considerations emerging from experimental results are presented for a first theoretical approach to channel blowdown phenomena. 3 references. (auth)

9097 TRENDS IN THE DESIGN OF PRESSURE VESSELS FOR NUCLEAR POWER STATIONS: SAFETY CONCEPT FOR A BOILING WATER REACTOR WITH PRESTRESSED CONCRETE PRESSURE VESSEL. Fuerste, W.; Schafstall, H. G. (Fried-Krupp GmbH Industriebau und Maschinenfabriken, Essen). Tech. Mitt. Krupp, Werksber.: 27: 117-22(Sep 1969). (In German).

The advantages offered by prestressed concrete pressure vessels with regard to the safety of boiling water reactors are discussed. Furthermore, a new safety concept for water reactors is described. 11 references. (auth)

9098 MAIN COOLANT PUMPS IN NUCLEAR POWER PLANTS. Honold, Ernst. Brennst.-Waerme-Kraft; 21: 522-6(Oct 1969). (In German).

The initial constructions of coolant circulation pumps for nuclear power plants are described, dealing in particular with the problems of shaft bearings and shaft seals. The further development of these pumps is discussed. (auth)

9099 THE RECUPERATOR OF A 1000 MWe FAST POWER REACTOR WITH DIRECT GAS TURBINE CIRCUIT. Burgsmueller, Peter (Sulzer AG, Winterthur, Switzerland); Roduner, Hans. Brennst.-Waerme-Kraft; 21: 527-31(Oct 1969). (In German).

The design of a 1000 MW(e) installation comprising a He-cooled fast reactor with a direct gas turbine circuit and the importance of the recuperator in this process are discussed. A favourable recuperator concept is selected on the basis of critical comparison. Finally the entire installation incorporating such a recuperator is optimized. (auth)

9100 ON THE WORLD'S HELIUM SUPPLY AND THE DEMAND BY HELIUM COOLED POWER REACTORS. Christensen, Joergen (Aktiebolaget Atomenergie, Stockholm). Brennst.-Waerme-Kraft; 21: 532-7(Oct 1969). (In German).

As the coolant medium in nuclear reactors, helium may become very important for the supply of electric energy. To what extent can the world's He supply and reserves be expected to satisfy the future demand for this purpose? On the basis of a review and estimate of the present market and reserves an attempt is made to answer this question, taking into account the possible demand development and pricing policy. (auth)

9101 ANALOGUE COMPUTER SIMULATION OF A STEAM-COOLED REACTOR CYCLE. Wanser, Klaus. Brennst.-Waerme-Kraft; 21: 538-42(Oct 1969). (In German).

In order to be able to investigate the dynamic behaviour of the cooling circuit in a nuclear power plant with the aid of an analogue computer, models of the individual elements are first designed.

The individual elements are then connected together according to a coupling plan, which makes it possible to investigate the effects of various disturbances on the cycle. (auth)

9102 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. (to Babcock and Wilcox Ltd.). British Patent 1,173,628. 10 Dec 1969. Priority date 18 Mar 1966, Germany.

Reference is made to thermal insulation for a reactor concrete pressure vessel. Such insulation has usually consisted of stainless steel lamina of high cost. The insulation described includes plates of ceramic material or heat-resistant glass, appropriately spaced and disposed in such a way as to inhibit the transfer of heat to the concrete by convection. The ceramic material or glass may be disposed between the inner boundary of the pressure vessel and a metallic lining, and may support this lining against pressure exerted within the lining. Various arrangements of the ceramic plates are described. (UK)

9103 NUCLEAR SUPERHEATING REACTOR. Aizu, Tadashi (to Hitachi Ltd.). Japanese Patent 1969-19997. 27 Aug 1969. Filed 26 Sep 1966.

The nuclear superheating reactor proposed is divided in two regions: the central steam superheating region, and the outer boiling-water region surrounding the central region. The boundary of the two regions is double-walled, with the inner wall forming the wall of the central superheating region, and the outer one being the inner wall of the surrounding boiling-water region. The advantages are effective cooling of the superheating core by spraying, when required, and easy exchange of fuel in the superheating region. Piping for spray-cooling enters the outer boiling-water region horizontally through the pressure vessel, below the level of the steam chamber in the top of the pressure vessel. After hitting the inner wall of the boiling-water region, the piping runs downward along the wall. The piping then penetrates the double wall at a point a little above the top of the superheating core. In this way the central reactor core is cooled effectively by the spray, and the exchange of fuel is not prevented. (NSA of Japan)

9104 IMPROVEMENTS IN AND RELATING TO GAS-COOLED NUCLEAR REACTORS. Brown, Gordon (to Atomic Power Constructions Ltd.). British Patent 1,173,338. 10 Dec 1969. Filed 14 Feb 1967.

Reference is made to gas-cooled reactors having a concrete pressure vessel with an inverted cup-shaped partition which is sealed at its lower end to the inner membrane of the pressure vessel, and separates the core from the heat exchangers. A recent development of this type of reactor employs re-entrant core coolant gas flow, a portion of this flow from the heat exchangers being passed downwards through the graphite of the core to combine with the remainder of the coolant gas before entering the fuel channels. With this form of reactor it is necessary to provide a reliable seal between the partition and the pressure vessel membrane floor; this leads to complications in shielding. Furthermore the seal must be flexible in order to accommodate differential movements between the partition and the pressure vessel, leading to complication and expense. In the arrangement described partitioning means are provided within the pressure vessel dividing the interior so as to form an inner chamber spaced from the inner surface of the pressure vessel by an outer chamber that completely envelops the partitioning. A core supporting lattice structure extends across the inner chamber to define within the lattice structure a plenum chamber. Heat exchangers are located around the partitioning in the outer chamber, and gas inlet and outlet means are provided so as to circulate the coolant gas into the plenum chamber, upward through the core supporting lattice structure and through the fuel channels, out of the gas outlet openings to the upper end of the outer chamber and downward over the heat exchangers to the gas inlet openings. A second plenum chamber may be provided between the lattice structure and the core; this second chamber may be found by spacing the lattice structure from the core, the spacing being effected by leveling screws. The radiation shield may be located within the partitioning. Various alternative arrangements are described. (UK)

Fuels

Refer also to abstract 8169.

9105 (DOCKET-50183-5) VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR. [Preliminary Safety Analysis Report], Amendment 2. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 27 Mar 1961. 2p. Dep. CFSTI.

The license application is amended concerning fission gas release levels from the UO_2 fuel. (H.D.R.)

9106 (ORNL-TM-2742) FAILURE MODES OF ZIRCALOY-CLAD FUEL RODS. PART 3. DESCRIPTION OF THE ORNL PROGRAM. Rittenhouse, P. L. (Oak Ridge National Lab., Tenn.). Jan 1970. Contract W-7405-eng-26. 42p. Dep. CFSTI.

Research and testing programs are being conducted at the Oak Ridge National Laboratory to determine the behavior of Zircaloy-clad fuel rods in the event of a loss-of-coolant accident in a light-water nuclear reactor and the effect of this behavior on the outcome of the accident. These studies will obtain information needed for the evaluation of the safety of large, modern, boiling- and pressurized-water reactors. The program scope includes studies of the high-temperature mechanical properties of Zircaloy cladding and its embrittlement by steam as well as the effect of cladding failure mode on recovery from the temperature transient associated with the accident. The progress of these programs in fiscal year 1969 is described, and plans for fiscal years 1970 and 1971 are discussed. 13 references. (auth)

9107 IMPROVEMENTS RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Ellington, John Peter; Swanson, Kenneth Macgregor; Clough, Roy (to United Kingdom Atomic Energy Authority). British Patent 1,170,062. 12 Nov 1969. Filed 30 Dec 1965.

Reference is made to fast reactor fuel elements or pins having ceramic fuel in a close fitting metal sheath. The design of fuel element described to meet thermal stress conditions, has metallic sheathing exposed externally to coolant, with ceramic fuel possessing in aggregate a density not exceeding 85% of maximum theoretical density in order to include distributed voidage. A solid interlayer is disposed between and directly contacting sheathing and fuel, and possessing thermal insulating properties such as to increase the fuel operating temperature and hence lower the compressive creep resistance, enabling swelling to be accommodated in the voidage. At least one coolant tube may be provided which penetrates the fuel to form an internal cooled surface, both the external and internal surfaces of the tube being exposed to coolant and the interlayer being provided only at the external cooled surface. The sheathing may also take the form of a metal shell with a layer of thermal insulating material forming the inner face and a number of metal coolant tubes within the shell to form the inner walls of the sheathing, the fuel being disposed inside the shell in the space between the tubes and the inner face of the layer of insulating material. The fissile material may be more highly concentrated in a region adjoining the interlayer than elsewhere, where a Pu fuel is employed it should be concentrated exclusively in the region adjoining the interlayer. (UK)

Auxiliary and Emergency Systems

9108 CHIMNEY FOR A NATURAL-CIRCULATION BOILING WATER REACTOR. Takayama, Takeo (to Hitachi Ltd.). Japanese Patent 1969-19996. 27 Aug 1969. Filed 30 Sep 1966.

With the chimney proposed for a natural-circulation boiling water reactor, the natural circulation of cooling water is improved, and the fuel can be exchanged simply and in a short time without removing the chimney. During reactor operation, the chimney fixes the fuel rods to the reactor-core frame. The chimney, set on top of the reactor core consists of side walls and partitioning plates attached to the chimney flange to divide the inside into a plurality of lattice spaces. A mechanism to fix and release fuel elements in the reactor is installed, through holes on the chimney wall. This mechanism includes guides, traversing at right angles, the partitioning plates, and also the side walls, and a plurality of the holding plates, fixed to the guides, which are located at the same intervals as the fuel elements and hold down the fuel element during the operation. (NSA of Japan)

Operation and Economics

9109 (CONF-681219-1) USE OF THE PLUTONIUM PRODUCED IN THE REACTOR CIRENE. Bruschi, C.; Goldaniga, G.; Reggiani, M. L.; Zorzoli, G. B. (Centro Informazioni Studi Esperienze, Milan (Italy)). [1968]. 50p. (In Italian). Dep. CFSTI (U. S. Sales Only).

From 10th International Nuclear Energy Conference, Milan, Italy.

Energy balances and fissile–fertile materials requirements for the CIRENE-type reactor are determined; data are tabulated for required fuel as a function of electrical output from the reactor. Costs of a CIRENE-type reactor are computed for three different sets of parameters, and include the bred-plutonium returns. Detailed economic evaluations of these three conceptual reactor designs are presented. (M.L.S.)

9110 (DOCKET-50018–5) [VALLECITOS BOILING WATER REACTOR]. Testimony of L. Kornblith, Jr. [(General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.]). 29 Mar 1960. 30p. Dep. CFSTI.

Testimony of the Manager of Reactor Technical Operation at the Vallecitos Atomic Laboratory concerning the VBWR is presented. Included are the facility licensing history, site and facility description, operating history, and modifications descriptions. (H.D.R.)

9111 (DOCKET-50018–6) VALLECITOS BOILING WATER REACTOR. Semiannual Report on Operating Experience Pertinent to Safety, No. 2. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 30 Mar 1960. 11p. Dep. CFSTI.

9112 (DOCKET-50018–9) VALLECITOS BOILING WATER REACTOR. Additional Information to Clarify Factors Discussed in Amendment 45. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 5 Sep 1961. 6p. Dep. CFSTI.

Additional information regarding design features and operation of the Superheat Fuel Demonstration Test Loop is presented. A schematic diagram of the loop is included. (H.D.R.)

9113 (DOCKET-50018–11) [VALLECITOS BOILING WATER REACTOR]. [Preliminary Safety Analysis Report], Amendment 5. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 10 Jun 1957. 26p. Dep. CFSTI.

Approval is requested for operation of the reactor as an atmospheric pressure critical assembly using plate-type fuel and without providing containment. Appendices provide information on: (1) operating procedures and scope of work, (2) analysis of the maximum credible incident, (3) the reactor description, (4) detailed operating instructions, and (5) the proposed disaster plan for the Vallecitos Atomic Laboratory. (H.D.R.)

9114 (DOCKET-50018–13) [VALLECITOS BOILING WATER REACTOR]. [Preliminary Safety Analysis Report], Amendment 9. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 11 Jul 1957. 15p. Dep. CFSTI.

Amendment 7 to the license application for the Vallecitos BWR is modified and supplementary information relating to power operation is presented. (H.D.R.)

9115 (DOCKET-50183–10) ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR (EVESR). [Preliminary Safety Analysis Report], Amendment 7. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 6 Mar 1963. 23p. Dep. CFSTI.

The license application is amended to present information on the possibility of moderator swelling effects under accident conditions and to submit a revised plan for conducting fuel tests in the reactor. (H.D.R.)

9116 (DOCKET-50183–11) ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR (EVESR). [Preliminary Safety Analysis Report], Amendment 8. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 27 Mar 1963. 13p. Dep. CFSTI.

The license application is amended to present information on the fuel transfer casks, fuel storage pool, reactivity testing during initial core loading and critical testing, and on the use of certain materials as startup sources and instrument calibration sources. (H.D.R.)

9117 (DOCKET-50183–12) ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR (EVESR). Proposed Technical Specifications. [Preliminary Safety Analysis Report], Amendment 9. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 10 May 1963. 63p. Dep. CFSTI.

9118 (DOCKET-50183–13) ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR (EVESR). Supplementary Information on Research and Development Instrumentation and Sampling Equipment. [Preliminary Safety Analysis Report], Amendment 10. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 15 May 1963. 7p. Dep. CFSTI.

Information concerning piping and instrumentation to be installed to implement planned research and development work is presented. (H.D.R.)

9119 (DOCKET-50183–14) ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR (EVESR). Technical Specifications. [Preliminary Safety Analysis Report], Amendment 11. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 7 Jun 1963. 65p. Dep. CFSTI.

9120 (DOCKET-50183–15) ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR (EVESR). [Preliminary Safety Analysis Report], Amendment 12. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 27 Aug 1963. 12p. Dep. CFSTI.

A revision to the Technical Specifications concerning the emergency cooling heat exchanger is presented. (H.D.R.)

9121 (DOCKET-50183–16) ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR (EVESR). Modification of Proposed Change No. 16. Safety Evaluation by the Division of Reactor Licensing. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 12 Jul 1966. 12p. Dep. CFSTI.

A change in the Technical Specifications concerning the limitation on the positive moderator temperature reactivity effect is presented. (H.D.R.)

9122 (DOCKET-50183–18) ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR (EVESR). License No. DR-10. Technical Specifications, Change No. 17. Safety Evaluation by the Division of Reactor Licensing. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 12 Sep 1966. 14p. Dep. CFSTI.

Approved changes in the Technical Specifications concerning control rods, thermal conditions, reactivity effects, and core composition are presented. (H.D.R.)

9123 (DOCKET-50183–19) ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR (EVESR). ACRS Report on Proposed Change No. 17. (Atomic Energy Commission, Washington, D. C. Advisory Committee on Reactor Safeguards). 16 Aug 1966. 2p. Dep. CFSTI.

The ACRS comments on proposed changes in the Technical Specifications are presented. The changes include: an increase in the maximum allowable specific power; an increase in allowable non-standard fuel; an increase in maximum clad temperatures; and changes in control rod materials, worth, and withdrawal pattern. (H.D.R.)

9124 (DOCKET-50183–20) [ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR (EVESR)]. Facility License No. DR-10, Amendment 1. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 17 Jun 1968. 16p. Dep. CFSTI.

The EVESR license is amended to authorize the General Electric Company to possess, but not to operate, the deactivated reactor. (H.D.R.)

9125 (DOCKET-50183–21) ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR (DEACTIVATED). Annual Report No. 1. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 4 Oct 1968. 7p. Dep. CFSTI.

9126 (HPR–115) HBWR QUARTERLY PROGRESS REPORT, JULY–SEPTEMBER 1969. (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). Nov 1969. 99p. Dep. CFSTI (U. S. Sales Only).

ALUMINUM—corrosion in Halden reactor primary circuit steam phase
HALDEN BOILING REACTOR—operations during July to September 1969
—fuel elements for, failure of test
—personnel radiation dose record for July to September 1969
—control system for, development of digital computer
—fuel burnup in, physics determinations for, (E/T)
—fuel elements for, post-irradiation testing of
—fuel can diameter in, development of gage for
RADIATION MONITORING—dose record for Halden reactor personnel during July to September 1969
REACTOR CONTROL SYSTEMS—development of digital computer, for HBWR
REACTOR FUEL ELEMENTS—failure in HBWR test assemblies
—radiation testing in HBWR
—can diameter gage for, development of
REACTOR FUELS—burnup in HBWR, physics determinations for, (E/T)
STAINLESS STEEL—corrosion in Halden reactor primary circuit steam phase
STEAM—corrosive effects on reactor structural metals
STEEL—corrosion in Halden reactor primary circuit steam phase
ZIRCALOY—corrosion in Halden reactor primary circuit steam phase (H.D.R.)

9127 (ORNL–4296) GENERALIZED CAPITAL AND OPERATING COSTS FOR POWER-INTENSIVE AND ALLIED INDUSTRIES. Goeller, H. E.; Mrochek, J. E. (Oak Ridge National Lab., Tenn.). Dec 1969. Contract W-7405-eng-26. 71p. Dep. CFSTI.

A supplement to Chap. 5 of ORNL-4290, Nuclear Energy Centers: Industrial and Agro-Industrial Complexes is presented to provide the interested reader with sufficient information to duplicate the computed cost results given in Chap. 5 and to make additional independent cost studies on the 17 chemical and metallurgical products considered. Included are (1) all of the equations and constants used in determining the various building block manufacturing cost components, (2) a brief description of the computer subroutines, including typical output data sheets, and (3) a set of tables for easily and quickly obtaining component costs at all of the reference values of all parameters used in the studies. A number of worked examples are given to illustrate use of these data, first for industrial building block cost determinations and then for both United States and non-United States industrial complexes. (auth)

9128 ON THE PROBLEMS OF OPTIMIZING LONG RANGE REACTOR PLANNING: POSSIBILITIES AND LIMITS OF MODEL CALCULATIONS. Finnemann, H.; Maerkl, H. (Siemens AG, Erlangen, Ger.). Atomwirt., Atomtech., 14: 368-72(July 1969). (In German).

Model calculations for the evaluation of a long-range reactor type strategy are detailed. Studies on the effect of given system parameters on the optimum strategy shows that the results of such optimization calculations depend strongly on variations of certain input data. Optimum energy and capacity distributions are shown for the various types of reactors, and projected to the year 2000. Effects of the fast breeder on the overall power strategies are considered. (M.L.S.)

9129 ECONOMIC OUTLOOK OF HEAVY WATER REACTORS. Mandel, H. (Rheinisch-Westfaelische Elektrizitaetswerk AG, Essen). Atomwirt., Atomtech., 14: 347-53(July 1969). (In German).

An investigation of the present state of development and the future economic outlook of heavy water reactors is discussed; the heavy water reactor concept with consequent use of the principle of the economic optimization, is considered for inclusion in light water reactor systems. The feasibility of such mixed systems is evaluated from economic and operational points. (TSS)

Safety and Siting

Refer also to abstracts 7522 and 9106.

9130 (CEA-CONF-1368) NUCLEAR REACTOR SAFETY. Furet, Jacques (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [1969]. 72p. (In French). Dep. CFSTI (U. S. Sales Only).

General considerations of the safety of reactors are outlined. Application of safety procedures to power reactors is discussed. The need for codes and standardizations in power reactor manufacturing and construction is assessed. The economics of safety and reactor safety are discussed. Methods for analysis of the safety of reactors are described. Safety systems and redundance effects are discussed. Details of the circuit (safety-redundance) algebra and logic are included. 14 references. (M.L.S.)

9131 (DOCKET-50183-1) ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR (EVESR). [Preliminary Safety Analysis Report], Amendment 5 (Includes Final Hazards Summary Report). (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 1 Oct 1962. 530p. (APED-3958). Dep. CFSTI.

Technical information and supporting data necessary for the conversion of the EVESR construction permit to an operating license is presented. Also included is the final hazards summary report, which details design and safety data on the reactor and associated facilities, operating procedures, and safeguards features. (H.D.R.)

9132 (DOCKET-50183-7) VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR. [Preliminary Safety Analysis Report], Amendment 3. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 14 Apr 1961. 34p. Dep. CFSTI.

Detailed answers to specific questions concerning the Preliminary Hazards Summary Report are presented. Information is included on: the bottom entry control rod design; the critical experiments program; cold unflooding of the process tubes; collapse of unflooded process tubes during an excursion; adequacy of the containment structure; containment leakage rate; reduction in containment fission product activity from washout; consequences of the MCA at 70 MW(t); and potential interactions between the VBWR and VESR. (H.D.R.)

9133 (KFK-1045) THE INFLUENCE OF NUCLEAR DATA UNCERTAINTIES OF REACTOR MATERIALS ON THE MAIN SAFETY AND STABILITY PARAMETERS OF A LARGE STEAM-COOLED FAST REACTOR (D-1 DESIGN). Broeders, C. H. M. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). May 1969. 81p. (EUR-4311; EURFNR-715). Dep. CFSTI (U. S. Sales Only).

Investigation of the D-1 design for a 1,000 MW(e) steam-cooled fast breeder reactor showed that the D-1 design is near the boundary of inherent stability. Within the expected uncertainties of the feedback coefficients the core may become unstable. In earlier studies, mainly on Na-cooled fast breeder reactors, it was found that the feedback coefficients are rather sensitive to the nuclear data uncertainties. Therefore, the influence of the nuclear data uncertainties on the main parameters for the safety and stability of the D-1 design are primarily investigated. These parameters are the Doppler coefficient and the steam-density coefficient. The influence of the data uncertainties on the loss of coolant reactivity, the conversion ratio of the core, and the amount of fissile material required is considered. Mainly the influence of the uncertainties of the capture and fission cross-sections is examined. Only for the materials ^{238}U and ^{239}Pu the influence of the inelastic cross-section uncertainties is considered. Most investigations were performed with the help of multi-group diffusion calculations in a fundamental mode approximation. For these calculations the KFK-SNEAK set was used as basic group constant set. After each cross-section variation the reactor parameters considered were calculated for a critical reactor. In order to obtain some general information about the influence of the nuclear data uncertainties on the Doppler coefficient and the steam-density coefficient, the effect on these parameters following a 10% increase in the macroscopic cross-sections for capture and fission are investigated. The influence of the data uncertainties of the reactor materials is calculated. For the Doppler effect, the results of different calculation methods are compared. The influence of the calculated reactor parameter uncertainties on safety, stability, and dynamic behavior of the D-1 design is investigated. 37 references. (auth)

9134 (ORNL-NSIC-71) INDEXED BIBLIOGRAPHY OF CURRENT NUCLEAR SAFETY LITERATURE-22. (Oak Ridge National Lab., Tenn.). Jan 1970. Contract W-7405-eng-26. 265p. Dep. CFSTI.

An indexed bibliography of current nuclear safety is presented. Bibliographic items are sorted into the following categories: General Safety Criteria; Siting of Nuclear Facilities; Transportation and Handling of Radioactive Materials; Aerospace Safety; Accident Analysis; Reactor Transients, Kinetics, and Stability; Fission Product Release, Transport, and Removal; Sources of Energy Release Under Accident Conditions; Nuclear Instrumentation, Control, and Safety Systems; Electrical Power Systems; Containment of Nuclear Facilities; Plant Safety Features; Radiochemical Plant Safety; Radionuclide Release and Movement in the Environment; Environmental Surveys, Monitoring and Radiation Exposure of Man; Meteorological Considerations; Operational Safety and Experience; Safety Analysis and Design Reports; and Bibliographies. (D.C.C.)

9135 PRESSURE LOSS INCIDENTS IN WATER COOLED REACTORS. PART I. RESULTS WITH GLASS CONTAINERS AT LOW PRESSURE. Kober, K.-J.; Leistner, G.; Zimmermann, M. (Battelle-Institut e.V., Frankfurt am Main). Atomwirt., Atomtech., 14: 357-9(July 1969). (In German).

The pressure loss of a boiling water reactor was simulated with model vessels of glass at pressures up to 2 atm. Photographs of the boiling process and pressure measurements were made at 2 atm operational pressure. The research results gave significant insights into the processes of sudden pressure loss. It was shown that the vessel pressure drops very abruptly at first but later drops more slowly. Pressure oscillations which occurred were caused by the boiling water being retained in the tubes. (TSS)

Power Conversion Systems

Refer also to abstract 8369.

9136 (APDA-TM-52) CRITERIA FOR DETECTION OF SMALL SODIUM-WATER REACTIONS IN LMFBR STEAM GENERATORS. Coleman, John H.; Ford, John A.; Lindsey, P. S. (Atomic Power Development Associates, Inc., Detroit, Mich.). 23 Nov 1969. 104p. Dep. CFSTI.

The major purpose of the development of leak detection systems for sodium-heated steam generators is to minimize the damage and large economic losses which can result from leakage of water into sodium. Only small leaks are considered in the analysis since adequate detection methods for large leaks exist and are in use. The criterion proposed for leak detection systems for small leaks is that these systems be capable of reliable detection so that the

steam generator may be shut down by removal of the water and steam from the unit before significant damage has occurred. Significant damage is defined as that amount of damage which, if not repaired, would appreciably decrease the service life of the steam generator. The major elements and input required for a leak detection analysis are defined and described in addition to an actual analysis of a reference secondary system for a 1000-MW(e) LMFBR plant. Candidate leak detection instruments were evaluated for their ability to meet the criterion stated above, and the requirements for a leak detection system were developed. These candidate instruments are the cover gas chromatograph, thermal conductivity cell, and pressure detector; the in-sodium rhometer, plugging meter, bubble meter, APDA hydrogen detector, and UNC oxygen meter; and the acoustic detector. (auth)

9137 THE ECONOMY AND THE OPERATIONAL AND DISTURBANCE CHARACTERISTICS AS FACTORS IN THE DESIGN AND CONSTRUCTION OF NUCLEAR POWER PLANTS WITH GAS TURBINES. Dibelius, G. (Technische Hochschule, Aachen); Foerster, S.; Hlubek, W. Brennst.-Waerme-Kraft; 21: 509-16 (Oct 1969). (In German).

Gas-cooled high temperature reactors can be coupled either to a secondary power cycle incorporating a steam turbine, or to a primary cycle with a gas turbine. The comparison presented shows the thermodynamic and the possible economic advantages of the gas turbine installation. It is, however, still necessary to find an economical overall concept with optimum operational and disturbance characteristics. The problems connected herewith, such as the connection of the components in the circuit, the expected partial load characteristics, the arrangement inside or outside the reactor vessel, the choice of gas pressure and type of gas, and the effect of disturbances are discussed. The trial, demonstration, and prototype installations provided for this line of development are described. (auth)

9138 TURBINES FOR LARGE CAPACITY NUCLEAR POWER PLANTS. Ludewig, Max (Kraftwerk Union AG, Muelheim, Ger.). Brennst.-Waerme-Kraft; 21: 516-21(Oct 1969). (In German).

The development of nuclear power plants in the German Federal Republic is discussed with reference to completed and projected installations. Constructional details of large capacity saturated steam turbines are mentioned and operational experience to date is given. The question of the most favorable turbine speed for single shaft turbo sets in nuclear power plants is dealt with. (auth)

Research and Test Reactors

Refer also to abstracts 7674, 8068, 8154, and 9077.

9139 (AAEC/TM-501) EXPERIMENTAL AND THEORETICAL INVESTIGATION OF THE DIFFERENTIAL NEUTRON ENERGY SPECTRUM AT THE CENTRE OF THE MOATA REACTOR. Dalton, A. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1969. 33p. Dep. CFSTI (U. S. Sales Only).

The neutron energy spectrum in graphite at the center of the MOATA reactor was measured over the energy range thermal to 500 eV. Three regions were observed in the spectrum: a Maxwellian peak at thermal energies, a 1/E component above about 100 eV, and a joining region in which the flux deviates from 1/E by 7 percent at 0.8 eV. The accuracy of the measurements was sufficient to establish the existence of a systematic error in the epithermal flux region above 5 eV. Calculations showed that a significant part of this could be attributed to scattering of neutrons into the detector by the surrounding media. 13 references. (auth)

9140 (CEA-CONF-1320) MAPS OF THERMAL NEUTRON FLUX IN THE REACTOR. Vacher, Jacques (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). June 1969. 23p. (In French). Dep. CFSTI (U. S. Sales Only).

Methods for measurement of neutron fluxes in reactors are outlined; brief discussions of foil activation techniques, use of semi-conductor detectors, and use of fission chambers are given. Flux mapping of the EDF-2 and Siloe reactors are described; results are shown graphically. (M.L.S.)

9141 (DOCKET-50047-2) HEALTH PHYSICS SURVEY OF 5 MEGAWATT OPERATION AT THE AMMRC NUCLEAR REACTOR. (Army Materials and Mechanics Research Center, Watertown, Mass.). 22 Oct 1969. 55p. Dep. CFSTI.

Design parameters of experimental facilities are presented. Radiation dose measurements for operational areas are listed. Monitoring of ^{41}Ar and ^{131}I activity in the air is described. Pool water monitoring procedures are also described. (D.C.C.)

9142 (DOCKET-50047-3) PRE-NEUTRON AND POST-NEUTRON TESTS IN SUPPORT OF 5 MW OPERATION OF THE AMMRC REACTOR. Facility License R-65. (Army Materials and Mechanics Research Center, Watertown, Mass.). 6 Nov 1969. 86p. Dep. CFSTI.

Performance tests for mechanical systems are described. Control rod reactivity worth measurements are presented. Flux distributions in the core are illustrated by graphs. (D.C.C.)

9143 (IFA-FR-75) POLAROGRAPHIC ANALYSIS FOR Ni, Fe, AND Cr IN THE WATER OF THE PRIMARY CIRCUIT OF THE IFA, BUCHAREST, WWR-S REACTOR. Alexan, Zamfira (Academia R. S. R., Bucharest. Institutul de Fizica Atomica). 1969. 4p. (In French). Dep. CFSTI (U. S. Sales Only).

9144 (IFA-FR-76) ANALYSIS OF HYDROGEN PEROXIDE AND OXYGEN IN THE COOLING CIRCUIT OF THE WWR-S REACTOR. Alexan, Zamfira (Academia R. S. R., Bucharest. Institutul de Fizica Atomica). 1969. 5p. (In French). Dep. CFSTI (U. S. Sales Only).

9145 (JUL-599-RX) INVESTIGATION OF THE ENERGY DISTRIBUTION OF NEUTRONS IN A BEAM TUBE OF A REACTOR WITH A LOW-PRESSURE CLOUD CHAMBER IN THE REGION OF 10 keV TO 1.5 MeV. Lang, Herbert (Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Reaktorexperimente). Jul 1969. 87p. (In German). Dep. CFSTI (U. S. Sales Only).

By means of an automatically controlled low pressure cloud chamber, the neutron spectrum ranging from 10 keV to 1.5 MeV was measured within the collimated beam of the FRJ reactor. Due to γ dose rate of 130 R/hour, low pressure cloud chambers were the only appropriate method for neutron flux determination. Beyond 1 MeV, neutron energy with high γ radiation background, scattering chambers are the preferred measuring technique. (H.B.G.)

9146 (NP-17844) CONTROL OF THE UNIVERSITY REACTOR BASED ON MEASUREMENT OF THE NITROGEN ACTIVITY IN THE COOLING WATER. de Vries, J. W. (Reactor Instituut, Delft (Netherlands). Jan. 1969. 43p. (In Dutch). (RI-111-69-1). Dep.

A general description is given of the Delft University Research Reactor. Use of a ^{16}N-detector for power distribution measurements is discussed; theoretical bases are established. (M.L.S.)

9147 (ORNL-4459, pp 116-19) SUPPORT FOR IN-PILE EXPERIMENTS. (Oak Ridge National Lab., Tenn.).

IN-PILE LOOPS—instrumentation for, summary of development at ORNL, Sept. 1968–Aug. 1969

REACTOR EXPERIMENTAL FACILITIES—instrumentation for, summary of development at ORNL, Sept. 1968–Aug. 1969 (D.C.C.)

9148 (ORNL-4459, pp 120-6) INSTRUMENTATION FOR REACTOR DIVISION EXPERIMENTS AND TEST LOOPS. (Oak Ridge National Lab., Tenn.).

CORROSION LOOPS—instrumentation for, summary of development at ORNL, Sept. 1968–Aug. 1969

IN-PILE LOOPS—instrumentation for, summary of development at ORNL, Sept. 1968–Aug. 1969

REACTOR EXPERIMENTAL FACILITIES—instrumentation for, summary of development at ORNL, Sept. 1968–Aug. 1969 (D.C.C.)

9149 (ORNL-TM-2758) THE HIGH FLUX ISOTOPE REACTOR (HFIR) CONTROL COMPUTER OPERATING SYSTEM. Danforth, H. P. (Oak Ridge National Lab., Tenn.). 21 Nov 1969. 15p. Dep. CFSTI.

A description of the major operating executive programs, job processing programs, program editor, and the on-line system modifier is given. The off-line functions, which are available to the system programmer, are listed and described in detail. The operating executive programs for the HFIR digital control system were modified and extended to produce an effective on-line control scheme as well as an efficient off-line program development mode. (auth)

9150 (ORNL-TM-2808) HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT, JULY-SEPTEMBER, 1969. McCord, R. V.; Corbett, B. L. (Oak Ridge National Lab., Tenn.). 16 Dec 1969. Contract W-7405-eng-26. 17p. Dep. CFSTI.

Operations and maintenance requirements are described. Design changes are listed. Radiation monitoring measurements are presented. (D.C.C.)

9151 (RT/FI-(69)4) SAFETY REPORT FOR THE ROSPO REACTOR MODERATED WITH WATER. Conversano, R.; San-

tandrea, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Dec. 19, 1968. 228p. (In Italian). Dep. CFSTI (U. S. Sales Only).

The water-moderated ROSPO reactor is described in detail. The characteristics of the control system, both the conventional and nuclear instrumentation, are discussed. The alarm and safety sequence is outlined. The radiation from the reactor and the shielding necessary are discussed. The nuclear characteristics and core parameters are given. The foreseeable causes of incidents and the precautions taken to prevent them are analyzed. The consequence of each type of incidence discussed is considered. (J.S.R.)

9152 (RT/GEN-(69)1(Vol.2)) SEVERAL TECHNIQUES FOR PROGRAMING THE WORK, CASACCIA 1967. Farinelli, U.; Fillarini, G.; Fioroni, F.; Merelli, A.; Moretti, S.; Musso, B.; Santandrea, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1969. 60p. (In Italian). Dep. CFSTI (U. S. Sales Only).

Application of the PERT-system to the experimental programs at the Casaccia Research Center is discussed. The carrying out of the research reactor work and the application of the PERT-system to this work are described. Use of the PERT-system in the planning for the Electronics Lab at the Center is discussed. Management of the overall research programs and the role of the PERT-system in the management are considered. (M.L.S.)

9153 (UCRL-7513(Rev.1)) CHARACTERISTICS OF THE LPTR FAST NEUTRON IRRADIATION FACILITY. Cummings, Garth E.; Pefley, Gordon V.; Medcalf, Alfred W. (California Univ., Livermore. Lawrence Radiation Lab.). 24 Sep 1969. 14p. Dep. CFSTI.

The Fast Neutron Irradiation Facility has been in operation at the Livermore Pool Type Reactor (LPTR) for over six years. This facility is used to irradiate samples in a neutron flux having an energy distribution approximating a ^{235}U fission spectrum. Two U–Al alloy plates convert thermal neutrons (from a graphite thermal column) to fission energy neutrons, yielding a flux between 10^{10} and 10^{11} n/cm^2-sec in the sample location. The air-cooled plates produce 1000 W of power with the LPTR at a nominal power level of 3 MW. (auth)

Rocket and Space Reactors

Refer also to abstracts 8049 and 8165.

Process Heat and Desalination Reactors

9154 AGR-HTR COAXIAL CORES FOR STEELMAKING. Andoh, M. (Kobe Steel Ltd., Japan). Nucl. Eng. Int.; 14: 1094-6(Dec 1969).

A concept is described in which a He-cooled HTR core working with a coolant temperature of 1200°C, is surrounded by a CO_2-cooled AGR core with a max. gas temperature of 650°C. Its primary purpose is the generation of super high temperature gas for the steelmaking and chemical industries, with electricity generated from the AGR core as a subsidiary product. (UK)

Marine and Portable Power Reactors

Refer also to abstract 7562.

9155 (DOCKET-50238-52) [N. S. SAVANNAH]. Operating License NS-1. Technical Specifications Change 21. (First Atomic Ship Transport, Inc., New York). 11 Dec 1969. 3p. Dep. CFSTI.

Modifications in personnel requirements are described. (D.C.C.)

9156 (DOCKET-50238-53) N. S. SAVANNAH. Operations Report, April 21-November 2, 1969. (First Atomic Ship Transport, Inc., New York). Dec 1969. 16p. (FAST-18). Dep. CFSTI.

9157 (RT/ING-(69)4) WATER LEVEL REGULATOR FOR A STEAM GENERATOR IN A MARINE REACTOR POWER PLANT. Iacovoni, F.; Merino, R. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1969. 127p. (In Italian). Dep. CFSTI (U. S. Sales Only).

A three element (water level, steam flow and generator feedwater flow) level regulator for a steam generator located in a pressurized water reactor plant for marine use is described. The control group parameters are determined both in relation to the stability of the regulator system and to the best possible functioning of the same. The equations relative to the generator and tube flow, and those concerning the controller and feedwater valve actuator are considered. The analytic equations have been simulated on the analog computer, PACE 231-R, and the results of the project variables, obtained through a graphic registration have been used for further modifications of the controller parameters. (auth)

9158 (WARD-104) ZERO POWER TESTS ON PM TYPE 4. REACTOR CORE I. Taylor, E. G.; Vukmir, A. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Oct 1969. Contract AT(30-1)-4014. 129p. Dep. CFSTI.

The purpose of the program was to experimentally confirm the analytical reactors physical design parameters for the PM Type 4 replacement cores. The reactors that are in service operate with the Type 2 cores which utilize fully enriched U in the form of stainless steel clad UO_2 tubular dispersion fuel elements. The Type 4 core utilizes 9.58% enriched U in the form of UO_2 pellets, clad in stainless steel. The facility, equipment, and the techniques of measurement and data analysis are described, and the results of the measurements are presented. (auth)

9159 FIRST OPERATING EXPERIENCE WITH THE NS OTTO HAHN. II. STARTUP AND FIRST OPERATING EXPERIENCE WITH THE FDR REACTOR. Hendl, G.; Koellmann, R.; Kostrzewa, S. (INTERATOM, Bensberg, Ger.). Atomwirt., Atomtech., 14: 344-7(July 1969). (In German).

The core loading and zero-power tests of the reactor are briefly described. The power tests and power behavior of the reactor are then discussed. The operational behavior after about a half year's trial showed that all installations and systems installed for nuclear propulsion are completely suitable. (J.S.R.)

9160 FIRST OPERATING EXPERIENCE WITH THE NS OTTO HAHN. I. EXPERIENCE WITH THE OPERATION OF THE SHIP. Ulken, D. (Instituts fuer Kernenergie-Schiffsantriebe der GKSS, Geesthacht, Ger.). Atomwirt., Atomtech., 14: 342-4(July 1969). (In German).

The operation of the propulsion reactor for the Otto Hahn and the FDR reactor behavior (advanced pressure water reactor) are described. In the operation of the ship, the effects of sea motion, the maneuverability, output of the installation, and temperature and climate behavior of the reactor installation are discussed. (J.S.R.)

Reactor Theory

Kinetics

9161 (RD/B/N-1410) A NEW VERSION OF THE PRIZE PROGRAM FOR COLLISION PROBABILITY CALCULATIONS IN R-Z GEOMETRY. Johnson, P. W.; Nunn, D. L. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Oct 1969. 71p. (RPLC/P-256). Dep. CFSTI (U. S. Sales Only).

The original U.K.A.E.A. program PRIZE was converted for use on the 360 computer. A number of new facilities were added, most important of which was a new axial boundary treatment. In its present form the program is coupled with PIP for the solution of the collision probability equations; it is intended soon to include it within WIMSD. A complete account is given of the new version of PRIZE, together with some results both on test cells, designed to illustrate the effects of different facilities, and also on an experimental cluster. (auth) (UK)

9162 REACTOR NOISE. Dragt, J. B. Atoomenergie Haar Toepass.; 11: 151-61(Jun 1969). (In Dutch).

The neutron multiplication in a low-power reactor is described. Fundamental results were deduced in relation to the statistical correlation existing between neutrons detected in various ways. Experimental methods for studying reactor noise are outlined, and the data obtainable from noise are discussed. The noise of power reactors is then discussed. (tr-auth)

Dynamics

9163 SIMULATOR FOR ^{135}Xe POISONING IN NUCLEAR REACTORS. Novelli, A. (Politecnico, Milan). Energ. Nucl. (Milan), 16: 588-92(Sept. 1969). (In Italian).

The use of analog techniques for simulation of ^{135}Xe poisoning in reactors is discussed. The equations governing xenon buildup

in a reactor system are given; the simulator circuits are shown schematically. (M.L.S.)

Experimental Applications

Refer also to abstract 7610.

9164 (RFP–1327) THE EFFECTS OF ENERGY SELF-SHIELDING IN REFLECTED AND MODERATED URANIUM METAL CRITICAL MASS CALCULATIONS. Hunt, Douglas C.; Coonfield, Donald C. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 29 Sep 1969. Contract AT(29-1)-1106. 16p. Dep. CFSTI.

The effects of energy shielding (i.e., flux depletion in high absorption energy regions) are studied on multigroup cross sections for enriched uranium metal systems by using several energy-shielding models. The neutron cross sections obtained are used in transport theory critical dimension calculations done with the Computer Code DTF-II. A 3 percent variation in slab thickness and 0.4 percent variation in sphere radius occur as the energy-shielding model is changed. Doppler temperature coefficients are found to be negative or zero in all cases with a maximum magnitude of $4.68 \times 10^{-6}°K^{-1}$. (auth)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 7483–7487, 7544, 7555, 7558, 7560, 7581, 7601, 7602, 7656, 8045, 8054, 8074, 8078, 8079, 8098, 8158, 8168, 8170, 8173, 8176, 8179, 8180, 8183, 8199, 8211, 8796, 8892, and 9077.

9165 NUCLEAR REACTORS SHUTDOWN. Dosch, Peter; Kraus, Hans J.; Uhrig, Hans (to Gesellschaft fuer Kernforschung mbH). U. S. Patent 3,483,082. 9 Dec 1969. Priority date 30 Mar 1962, Germany.

A system for shutting down nuclear reactors is described which includes a safety rod and means for actuating the safety rod. The actuating means is an electromagnetic impulse generator, which generates a repulsive force. (Offic. Gaz.)

9166 IMPROVEMENTS IN AND RELATING TO THE INSULATION OF THE WALLS OF RELATIVELY LARGE VESSELS. Tisdall, Derek Edmond ; Laing, George William (to Darchem Engineering Ltd.). British Patent 1,171,403. 19 Nov 1969. Filed 8 May 1967.

The object of the arrangement described is to provide a sealing assembly capable of being welded to the cold face of the vessel and which can accommodate large temperature gradients without significant distortion and at the same time provide discrete compartments. A system of sealing assemblies is provided in which the edges of corrugated foil are secured to bars, and the latter are secured to the vessel wall to form a pattern of compartments; the foils are bent up into a position such that shaped insulating packs can be inserted into the compartments. Flattened ears may be provided at the end of each length of foil, the ears being welded together by overlapping spot welds. Cover plates may be provided for the compartments, arranged in staggered relation so that the joints between adjacent compartments do not coincide with the joints between adjacent cover plates. (UK)

9167 NUCLEAR REACTOR CONTROL ROD DRIVE MECHANISM. Selvey, John (to Nuclear Design and Construction Ltd.). British Patent 1,174,010. 10 Dec 1969. Filed 1 Jun 1967.

Reference is made to control rod drive mechanisms for reactors having at least one vertical control rod channel in the core extending over the height of the core. The drive mechanism described comprises a flexible elongated support member connected at one end to the upper end of the control rod, together with an endless flexible band wound around a number of pulleys, the other end of the support member being connected to a point on the endless band. The arrangement is such that the support member is of sufficient length to permit the control rod to drop from a fully retracted position above the control rod channel to a fully inserted position within the channel. The drive means is operable to drive the endless band around its pulleys and thus wind the support member on to the pulleys so as to return the control rod to its fully retracted position. The support member and endless band may be in the form of roller chains. One of the pulleys is connected to a drive motor and at least one pulley has a fixed sprocket for driving the endless band roller chain. At least one other pulley has a further fixed sprocket for the support roller chain so as to ensure that the connection between the support and endless band roller chains does not carry the full weight of the control rod. (UK)

9168 NUCLEAR REACTOR FUEL HANDLING ARRANGEMENTS. Burton, John Cornelius; Long, Frank Charles; Walker, Desmond John (to English Electric Co. Ltd.). British Patent 1,169,214. 29 Oct 1969. Filed 1 Apr 1966.

Reference is made to handling systems for fuel arranged as stringer assemblies, that is with the fuel elements joined together either by a central tie-rod or other suitable means. Conventional fuel handling and disposal arrangements occupy a great deal of space compared with the reactor itself, and the transportation of irradiated fuel and other components on the pile cap presents hazards. The fuel handling system described includes a rotatable gas-cooled carousel having a number of vertical tubes, loading means below the level of the carousel for removal or insertion of components from the vicinity of the reactor, a duct for giving access between appropriate carousel tubes and a fueling machine, and between appropriate carousel tubes and the loading means, also a grabhead for transfer of components, and means for dismantling a fuel stringer supported in the carousel. The loading means, handling means and dismantling means are all interconnected so as to be able to communicate with the carousel directly and in isolation from the ambient temperature. The handling means and loading means are arranged in line with each other, with the carousel between them, so that both may be operated simultaneously on an appropriately positioned carousel tube. Tie-rod releasing and removal means are described; these can operate successively without intermediate movement of the carousel. Tie-rod cutting and disposal means are also described. The system also provides for assembly of a fuel stringer in the carousel tube. A gas-cooled magazine tube is also described. (UK)

9169 IMPROVEMENTS RELATING TO SERVICING TOOLS FOR NUCLEAR REACTORS. Nicholls, Thomas Cooper (to Fairey Engineering Ltd.). British Patent 1,166,254. 8 Oct 1969. Filed 17 Sep 1965.

Reference is made to tools which can be lowered on a hoist suspension into a selected fuel channel for dismantling a fuel stringer and removing its parts from the channel. The tool incorporates a power driven shearing device with which to shear a broken stringer tie rod and retain the sheared-off portion. It also incorporates a television camera of capsule form and means for actuating the shearing device by remote control while under supervision by the camera. The power driving means may comprise an electromagnetic solenoid or hydraulic or pneumatic ram. A grab is provided at the lower end of the tool for engagement with the upper end of a fuel element to enable the element to be hoisted by the tool. The grappling head may be detachably mounted and provided with a remote controlled latch for releasing the head from the tool body in order to jettison the head complete with fuel element. Various designs of grappling head are described. (UK)

9170 IMPROVEMENTS IN AND RELATING TO SUPPORT CABLES FOR NUCLEAR REACTOR FUEL ELEMENTS. Oldham, Charles Robert (to Nuclear Power Group Ltd.). British Patent 1,174,122. 10 Dec 1969. Filed 23 Jun 1967.

Where fuel channels are disposed vertically in a reactor, loading and unloading of fuel elements is usually accomplished by suspending each fuel element from a support cable. A mechanically operable grab may be attached to the lower end of the cable to hold the fuel element, and such a grab may be provided with electrical locking means. It is convenient in such an arrangement to supply electrical power for operating the grab through the supporting cable. The support cable described has an electrical lead extending along its axis and the lead is provided with a number of clearance fitted insulating beads, with spacers located at intervals along the lead and separating the insulating beads into groups. A flexible containment tube surrounds the beads and a load carrying layer surrounds this tube. The electrical lead may consist of multi-strand wire rope, and the insulating beads may be of quartz. The spacer members may take the form of metal tubes adapted to slide over the electrical leak, each such tube having a flange at each end. The containment tube may be formed of spirally wound corregated steel strip, adjacent edges of which interlock, and the load carrying layer may consist of metallic braid surrounding the tube. The method of assembly of the cable is described. (UK)

9171 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Clapham, Leslie; Chetter, John (to United Kingdom Atomic Energy Authority). British Patent 1,173,902. 10 Dec 1969. Filed 10 May 1966.

Reference is made to fuel elements in which end fittings, such as cups and cones to provide stacking of the elements, are threaded for screwed engagement with the end caps closing the ends of the protective sheath. In the design described the end fittings are prevented from unscrewing from the end caps by locking rings joined to the end fitting shrouds, these locking rings having at least one integral projection which engages with a locking recess in the fuel element sheath. (UK)

GENERAL

9172 (ANL-Trans-790) ACRIDINE DYES AS EFFECTIVE REGULATORS OF PHOTOCHEMICAL REACTIONS IN NUCLEIC ACIDS. Zavil'gel'skii, G. B.; Rudchenko, O. N.; Danileichenko, V. V. Translated for Argonne National Lab., Ill., from Biofizika; 14: 34-40(1969). 15p. Dep. CFSTI.

9173 (BNL-14084) ACUTE LEUKEMIA: IS THERE A RELATIONSHIP BETWEEN CELL GROWTH KINETICS AND RESPONSE TO CHEMOTHERAPY? Cronkite, Eugene P. (Brookhaven National Lab., Upton, N. Y.). Oct. 22, 1969. 315p. (CONF-680967-1). Dep. CFSTI.

From 6th National Cancer Conference, Denver, Colo.

9174 (BNL-14190) GRANULOCYTOPOIESIS. Cronkite, Eugene P.; Vincent, Paul C. (Brookhaven National Lab., Upton, N. Y.). [1968]. 32p. (CONF-691107-1). Dep. CFSTI.

From Conference on Cell Proliferation, Boston, Mass.

The stem cell input into granulopoiesis has been estimated to be $1/_{16}$ of the granulocyte turnover rate in the blood. The current model states that there is one mitosis at level of myeloblast and promyelocyte and two mitoses at myelocyte level on the average. The transit time from stem cell to blood granulocyte is so long that we believe sustained granulocyte turnover rates are accomplished by shortening the generation time and thus allowing additional amplifying mitoses at the myelocyte level. One can hypothesize then that in these normal conditions the concentartion or intensity of the differentiating stimulus unlocks a number of transcription sites that sets the rate of protein synthesis and thus cell hypertrophy so that there will be roughly 4 divisions between the stem cell and the metamyelocyte. If the intensity of the chemical stimulus for differentiation which derepresses transcription sites is greater, the rate of cellular hypertrophy will be greater and cells will divide more times before the critical concentration is reached increasing the amplification factor of the stem cell. This concept requires that the generation time becomes shorter. Unfortunately, we do not as yet have the experimental data to test the concept. (auth)

9175 (EGG-1183-493) R. F. TRANSMITTER TYPE TM-21. Technical Manual No. B-3981. Stone, Paul A. (EG and G, Inc., Bedford, Mass. Eastern Science and Technology Div.). 31 Mar 1969. 34p. Dep. CFSTI.

9176 (EGG-1183-505) SERVICE GUIDE FOR CA-76 AND CA-77 OSCILLOSCOPE CAMERAS. Technical Manual No. B-4036. Wurlitzer, P. (EG and G, Inc., Bedford, Mass. Eastern Science and Technology Div.). 11 Jun 1969. 71p. Dep. CFSTI.

9177 (EGG-1183-507) LASL RADIO COMMAND SYSTEM, TYPE SY-199. Technical Manual Number B-4041. Finneran, William J.; Stanely, John (EG and G, Inc., Bedford, Mass. Eastern Science and Technology Div.). 27 Jun 1969. Contract AT(29-1)-1183. 27p. Dep. CFSTI.

9178 (EGG-1183-512) SATELLITE COMMUNICATIONS STUDY: PRELIMINARY REPORT. Technical Report Number B-4048. Sundstrom, C.; Brown, W. (EG and G, Inc., Bedford, Mass. Eastern Science and Technology Div.). 3 Jul 1969. 85p. Dep. CFSTI.

LASL has established the need for a satellite communications system to provide a reliable, long-range timing relay and voice communications link between ground stations and diagnostic aircraft, and between aircraft dispersed over vast areas. A study into the potentials of a satellite link to provide the required communications is presented. The concept of satellite communications, tests, future status and considerations, and conclusions pertinent to this program are outlined. (auth)

9179 (GEMP-713) LIFE TESTING OF SMALL DIAMETER THERMOCOUPLES AS A FUNCTION OF THERMAL CYCLING TEST NO. 3. Baxter, W. G.; Conner, D. E.; Rauch, W. H. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). Oct 1969. Contract AT(40-1)-2847. 20p. Dep. CFSTI.

Seven small diameter (.0625") stainless steel sheathed, MgO insulated thermocouples were tested in the GE-NSP air heated, steam cooled thermal cycling test rig. Four Type "K" (Chromel-Alumel) and three Type "T" (Cu-Constantan) thermocouples were evaluated through 1387 thermal cycles of 1200°F-600°F. One Type "K" thermocouple failed after 732 cycles. The remaining couples were functional at the conclusion of the test. (auth)

9180 (GEAP-10007) RESTART FOR THE PAPA PROGRAM. Ritze, G. O. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Mar 1969. Contract AT-(04-3)-189. 49p. Dep. CFSTI.

The restart features of the PAPA computer program, as written in FORTRAN IV for use on a GE-635 computer, are described. Users manual and a programmers reference manual are presented. Examples of all restart messages and re-initiation features of the program are discussed. (auth)

9181 (IS-2194) CONTRIBUTION TO THE THEORY OF OPTICAL REFLECTION AT A METAL SURFACE. Keller, Joseph M. (Ames Lab., Iowa). Oct 1969. Contract W-7405-eng-82. 26p. Dep. CFSTI.

9182 (LA-4268) ON RANDOM SEQUENCES OF INTEGERS. Everett, C. J.; Stein, P. R. (Los Alamos Scientific Lab., N. Mex.). Sep 1969. Contract W-7405-eng-36. 9p. Dep. CFSTI.

A "single transit" method of producing a random sequence of integers with a given expected average density is developed, which is simpler, faster, and more flexible than "sieve" devices, and admits of easy statistical analysis, being a straightforward application of the classical "Poisson sequence of trials." Specifically, if F(x) is a suitable function, a sequence P(n), $n \geq 1$, may be defined such that, if n is accepted for the random sequence B with probability P(n), then $P\{|B(N) - F(N)| < 3\rho\ F(N)\} > 1 - 1/\rho^2(1-p)$-$F(N) \to 1$, where B(N) is the number of accepted $n \leq N$ in B, and 3ρ is any prescribed relative error, with $0 < \rho < 1$. Some results on gap distribution, and the "Goldbach property," are included for their mathematical interest. For example, it is shown that almost every sequence of "random primes" contains an infinity of "twins," and for almost every such sequence, every sufficiently large even integer is a sum of two distinct integers of the sequence. (auth)

9183 (LA-4275) MATRIX DESCRIPTION OF THE FAST FOURIER TRANSFORM. Kahaner, David K. (Los Alamos Scientific Lab., N. Mex.). Jul 1969. Contract W-7405-eng-36. 26p. Dep. CFSTI.

Recently the fast Fourier transform has been described in terms of a matrix factorization. These results are derived in detail and the explicit factored form is given from which one can obtain the computer algorithm, the necessary label permutations, and the number of arithmetic operations required in the calculation. (auth)

9184 (LA-4281) NUMERICAL METHODS FOR FLUID DYNAMICS, AN ANNOTATED BIBLIOGRAPHY. Harlow, Francis H. (Los Alamos Scientific Lab., N. Mex.). Sep 1969. Contract W-7405-eng-36. 10p. Dep. CFSTI.

The contents of numerous publications in the field of numerical fluid dynamics are briefly described. Emphasis is on papers describing methodology for transient problems in several space dimensions. (auth)

9185 (LA-4290) EXTENSIONS OF SOME RESULTS ON SINGULAR PERTURBATION PROBLEMS WITH TURNING POINTS. Dorr, Fred W.; Parter, Seymour V. (Los Alamos Scientific Lab., N. Mex.). Oct 1969. Contract W-7405-eng-36. 16p. Dep. CFSTI.

Some extensions and applications of results contained in a recent paper on singular perturbation problems for ordinary differential equations are presented. (auth)

9186 (LA-4296) ANALYSIS OF THE SPURIOUS FREQUENCY RESPONSE OF MIXERS. Wageman, William E. (Los Alamos Scientific Lab., N. Mex.). Sep 1969. Contract W-7405-eng-36. 10p. Dep. CFSTI.

The spurious frequency response of mixers is discussed and the use of a desk-top electronic calculator to find these spurious frequencies is illustrated. Programs are given to calculate the frequencies at which the designer can expect to find trouble with a specified set of input and output frequencies. Both sharply tuned and broadband output mixers are considered. (auth)

9187 (NYO-1480-119) AN INTERFACE BETWEEN A CONTROL DATA 6000 SERIES COMPUTER AND A HONEYWELL 16-BIT SERIES COMPUTER. Bianchini, Ronald P. (New York Univ., N. Y. AEC Computing and Applied Mathematics Center). Oct 1969. Contract AT(30-1)-1480. 44p. Dep. CFSTI.

9188 (NYO-3497-21) THE BIOLOGY AND CHEMISTRY OF TRACE ELEMENTS IN MARINE AND ESTUARINE WATERS. Progress Report, December 1, 1968-November 30, 1969. (Johns Hopkins Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.). Contract AT(30-1)-3497. 80p. Dep. CFSTI.

9189 (ORNL-4479) CONDENSATION ON FLUTED SURFACES. Kurtz, L. A. (Oak Ridge National Lab., Tenn.). Dec 1969. Contract W-7405-eng-26. 67p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee [Knoxville].

The condensation of vapor on a fluted surface is studied. Due to the large surface tension on the liquid film, the condensate is drained away and thus the efficiency of the condensation process is increased. The motion of the liquid film can be described—after some simplifications—by a fourth-order nonlinear parabolic partial differential equation. A difference scheme is developed to approximate this differential equation and the questions of stability and convergence are investigated. Due to the nonlinearity of the problem the stability of this numerical procedure depends on several parameters, including $\Delta z/\Delta s^4$, Δs, ϵ, and initial values of ϵ, where Δz and Δs are the "time" and "space" steps and ϵ is the liquid film thickness. Artificial constant initial values must be given. Within the limits of stability these artificialities are rapidly smoothed out, and in fact the effect of a change in the initial conditions dies out with an increasing number of iterations. Some numerical experiments are carried out with this scheme and the results are discussed. (auth)

9190 (ORNL-TM-2613) ELECTRON ATTACHMENT TO POLYATOMIC MOLECULES. Chaney, E. L.; Christophorou, L. G. (Oak Ridge National Lab., Tenn.). Jan 1970. Contract W-7405-eng-26. 131p. Dep. CFSTI.

Thesis. Submitted by E. L. Chaney to Univ. of Tennessee, Knoxville.

9191 (ORNL-TM-2801) GENETICS OF BACTERIA IN VIVO AS RELATED TO MICROBIAL ECOLOGY. Jones, Randall T. (Oak Ridge National Lab., Tenn.). Jan 1970. Contract W-7405-eng-26. 105p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee [Knoxville].

This study attempts to show how the availability of germfree mice and modern techniques of microbial genetics can be used to to set up model systems in which studies on microbial ecology and genetic exchange in vivo between bacterial species can be undertaken. The ecological niche chosen for these studies was the gastrointestinal tract of mice. The microbial flora of the conventional mouse was found to be extremely complex. Several genera of bacteria were consistently present in fecal samples from these animals. Usually more than one species of each genus was present. Bacteroides and Lactobacillus species were the most common of the more easily cultivated anaerobes found. Oxygen sensitive fusiform bacteria were always observed microscopically. Several species of group D streptococci and various members of enteric group of bacteria (Enterobacteriaceae) were consistently isolated from normal fecal samples. The most common members of the enteric group found in mice were various strains of E. coli. Based on differences in carbohydrate fermentation and antibiotic and bacteriophage sensitivity patterns, 29 E. coli strains isolated from mice housed in the same environment could be divided into as many as 15 diferent types. About 30 per cent of the E. coli strains tested had complex growth requirements. Almost half (41 per cent) of the strains were unable to utilize lactose as a sole carbon source. E. coli strains of mouse origin were developed which had stable, well-defined genetic traits and which could be easily selected for by direct plating techniques from a mixed flora. It was possible to establish an artificial flora in germfree mice using representative genera originally isolated from mice. Although the artificial flora was much simpler than that of conventional mice the titers of the individual components did not differ much from those observed in samples from conventional mice. The genetically marked E. coli strain M13-24 remained stable for all its genetic traits during growth in vivo and in vitro. It was shown that E. coli strains differ in their ability to establish in mixed populations in the mouse intestine. An E. coli strain of mouse origin (strain M7) appeared to be well adapted to this in vivo environment and was able to establish and gain ascendancy over other E. coli strains in the mouse. This strain became genetically unstable with regard to its ability to ferment maltose in the in vivo environment. Based on reversion frequencies from mal^- to mal^+, the mal^- mutants appeared to be of different origins. Some reverted at high frequencies while others appeared to be non-reverting. Based on differences in the frequencies of mal^+ recombinants obtained from crosses between selected mal^- mutants and Hfr strains having different origins of chromosome transfer it was shown that the mal^- mutations occurred in either the malA or malB region of the chromosome. Further it was shown that E. coli strain M7 carried a transmissible R factor (ROR-1) which conferred resistance to high levels of tetracyclines and low levels of ampicillin and streptomycin. Germfree mice contaminated with selected E. coli strains were used for experiments designed to demonstrate gene transfer and recombinant formation in vivo. Contamination of germfree mice with the F^- recipient strain χ820 followed by the addition of Hfr, F′ and F^+ K-12 donor strains resulted in the appearance of all recombinant classes at frequencies that would be expected in an in vitro mating experiment. Inheritance of unselected donor markers occurred at frequencies that were dependent on linkage relationships established in in vitro experiments. The R factor ROR-1 was transferred from E. coli strain M7-18 to strain χ820 in the mouse intestine. (auth)

9192 (ORO-3626-2) MECHANISM OF THE FORMATE HYDROGENLYASE REACTION. Progress and Final Report, March 1, 1967–February 28, 1969. Peck, Harry D. Jr. (Georgia Univ., Athens). Contract AT(40-1)-3626. 21p. Dep. CFSTI.

9193 (ORO-3628-7) LYSOSOMES AS MEDIATORS OF RHEUMATOID ARTHRITIS. Spitznagel, John K. (North Carolina Univ., Chapel Hill. School of Medicine). [nd]. Contract AT(40-1)-3628. 19p. (CONF-690714-1). Dep. CFSTI.

From 4th International Congress of Pharmacology, Basel, Switzerland.

9194 (RLO-1927-42) RAUSCHER VIRAL LEUKEMOGENESIS IN BALB/c MICE TREATED WITH RABBIT ANTI-MOUSE THYMOCYTE SERUM. Siegel, Benjamin V.; Morton, Jane I. (Oregon Univ., Portland, Medical School). [1969]. 23p. Dep. CFSTI.

A regimen of multiple injections of a highly immunodepressive antithymocyte serum was effective in delaying splenomegaly in Rauscher virus-infected BALB/c mice. While extensive antiserum treatment proved to be toxic to virus-inoculated animals, a program of 6 injections, 3 administered prior and 3 subsequent to viral inoculation, delayed the onset of deaths of infected animals by about 1 to 2 weeks and gave significantly increased survivals. A single injection of 0.5 ml ATS given 2 days before Rauscher virus infection was found to have no significant effect on the course of the leukemic process. These observations have suggested that the influence of antilymphocyte serum on Rauscher leukemogenesis may be a consequence of changes in numbers and properties of viral target cells. (auth)

9195 (SC-CR-68-3644) DETONATOR CIRCUIT CALCULATIONS: RESISTIVITY FUNCTIONS. Work Manual, Issue 1. Blackburn, J. H.; Muller, G. M. (Stanford Research Inst., Menlo Park, Calif.). Apr 1968. Contract 58-2627. 143p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

9196 (SC-CR-69-3204(Draft)) EXPLODING WIRE DETONATORS: RESISTIVITY FUNCTIONS AND INITIATION CRITERIA FOR CIRCUIT CALCULATIONS. Work Manual, Issue 2. Blackburn, J. H.; Muller, G. M. (Stanford Research Inst., Menlo Park, Calif.). 10 Jun 1969. Contract 58-4235. 281p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

9197 (SC-DR-69-449) A PROCEDURE FOR COMPUTING AERODYNAMIC HEATING ON SPHERE CONES. PROGRAM BLUNTY. VOLUME II. EQUATIONS, OPERATING PROCEDURE, AND PROGRAM DETAILS. Hochrein, G. J. (Sandia Labs., Albuquerque, N. Mex.). Nov 1969. 97p. Dep. CFSTI.

A procedure for computing aerodynamic heat transfer rates to sphere cones at zero angle of attack is presented. This procedure employs curve fits of the shock shape and static pressure distributions together with a streamtube mass balancing technique to compute the necessary flow-field properties. Computations can be performed for an ideal gas or for air in thermodynamic equilibrium. A computer program, BLUNTY, is based on this procedure. This program serves as a useful tool for quickly computing accurate heat transfer distributions on sphere-cone reentry vehicles. Volume I presents a general description of the procedure used in program and a comparison of program results with actual flight data. This volume presents the equations, operating procedure, and details of the program. (auth)

9198 (SC-R-112-A) TOLERANCE COMPARATOR. Nicovich, P. A. (Sandia Labs., Albuquerque, N. Mex.). Nov 1969. 10p. Dep. CFSTI.

The fabrication of machine parts with circular features begins with engineering drawings on which the tolerances are conventionally designated in terms of a diameter. Actual production of the part is accomplished by machining operations and inspection measurements usually made coordinately along mutually perpendicular planes or axis. A comparator device, or visual slide calculator, designed to permit quick and accurate comparisons of bilateral tolerances and coordinate measurements with position tolerance diameters is described with instructions on its use. The device is included with the report. (L.C.L.)

9199 (SC-RR-68-296) CONVERSION OF SYNTHETIC RESINS TO AMORPHOUS CARBON. Mackay, Harold A. (Sandia Labs., Albuquerque, N. Mex.). Jul 1969. 30p. Dep. CFSTI.

9200 (TID-3755) BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. Issued or in Progress During the Period, September–October 1969. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 10p. Dep. CFSTI.

9201 (UCRL-19089) ELECTRO- AND MAGNETO-OPTICAL EFFECTS. Shen, Y. R. (California Univ., Berkeley. Lawrence Radiation Lab.). Oct 1969. Contract W-7405-eng-48. 25p. (CONF-691111-1). Dep. CFSTI.
From Ceramics Conference, Gainesville, Fla.

9202 (UCRL-50650) WISPIN COMPUTER PROGRAM FOR SIMULATION OF WISP INERTIAL NAVIGATOR. Henderson, Robert (California Univ., Livermore. Lawrence Radiation Lab.). 23 Apr 1969. Contract W-7405-eng-48. 91p. Dep. CFSTI.

A method is presented to directly simulate the operation of an inertial navigation system. Errors in velocity, position and gyro torquing signals are determined for a particular set of input data rather than statistical estimates of the errors. The advantages of this method are a more direct simulation of the reference platform control signals and greater flexibility in gyro drift and vehicle motion input. The basic navigation equations for velocity, position and gyro torquing signals are given. Their modification for platform control and the numerical solution by the simulation program are described in detail. (auth)

9203 (UCRL-50697) METHOD OF UTILIZING SPARK-GAP FOIL SWITCHES IN DETERMINING DETONATION VELOCITIES OF SOLID EXPLOSIVE MATERIALS. Carter, Gary W. (California Univ., Livermore. Lawrence Radiation Lab.). 11 Aug 1969. Contract W-7405-eng-48. 10p. Dep. CFSTI.

The application and method of applying spark-gap foil switches to high explosives are discussed. Although the use of spark-gap switches is not new, the recent development of etched copper/polyester switches makes possible simple installations on solid high explosives for determining detonation velocities. The spark-gap switches are also adaptable for use on explosives with irregular configurations. (auth)

9204 (UCRL-71959) SODT: A SCOPE OCTAL DEBUGGING TAPE FOR FAMILY-8 COMPUTERS. Bystroff, R. I.; Anderson, Roger E. (California Univ., Livermore. Lawrence Radiation Lab.). 6 Nov 1969. 18p. (CONF-691110-1). Dep. CFSTI.
From DECUS Fall Symposium, Las Vegas, Nev.

Display techniques are accepted as a powerful tool for interactive work. To date, debugging tapes for the PDP-8 family of computers have not included this feature. SODT provides this capability and frees the operator from distracting and slow typeouts of register contents. A simultaneous presentation of all pertinent registers allows the operator to react more quickly. Interpretive execution of the operator's program within the debug package is a new feature for small computer debugging programs. It enables the debugging program to set breakpoints automatically at the address specified. It also allows the debug program to follow branching instructions independent of the branch choice. With this feature, the flow and execution of the operator's program can be observed at teletypewriter speeds, or under fingertip control. (auth)

9205 (UCRL-Trans-10410) STATISTICAL DIMENSION CONTROL OF A LATHE. Pias, J. Translated by L. Kapp (Lawrence Radiation Lab., Livermore, Calif.), from CIRP, Ann. Int. Inst. Prod. Eng. Res.; 17: (1969). 32p. Dep. CFSTI.

The automatic compensation of systematic dimensional errors is the only means for optimizing the statistical behavior of an automatic lathe. The optimization of a system designed for this purpose is described. The theory, which makes use of computer simulation, is discussed, and experimental and theoretical results are compared. (auth)

9206 (UCRL-Trans-10415) COMPENSATION METHOD FOR FLATNESS MEASUREMENTS. Kilpi, J. Translated by L. Kapp (Lawrence Radiation Lab., Livermore, Calif.), from CIRP, Ann. Int. Inst. Prod. Eng. Res.; 17: (1969). 16p. Dep. CFSTI.

A compensation method in accordance with the method of least squares is presented for beam comparator measurements. The rectangular measuring pattern comprising 9 points is measured along the edges, diagonals and lines going through the center, parallel to the edges. By introducing the results of the measurements into the equations derived, the compensated result is obtained. The method can also be used for other measurements from which the deviations from a straight line, corresponding to beam comparator readings, can be calculated. (auth)

9207 (UCRL-Trans-10418) THE DEPENDENCE OF THE DIFFUSION COEFFICIENT ON THE CONCENTRATION. Kruecke, E.; Ley, H. Translated by Z. St. Gallay (Lawrence Radiation Lab., Livermore, Calif.), from Z. Phys. Chem. (Frankfurt); 26: 187-213(1960). 42p. Dep. CFSTI.

9208 (UR-49-1200) ADULT LEAN BODY MASS DECLINES WITH AGE: SOME LONGITUDINAL OBSERVATIONS. Forbes, Gilbert B.; Reina, Julio C. (Rochester Univ., N. Y. School of Medicine and Dentistry). [1968]. 27p. Dep. CFSTI.

Lean body mass, as estimated from ^{40}K counting, declines progressively during adult life. The rate of decline tends to speed up in later years, and is somewhat greater in the male. By age 65 to 70 the average male has 12 kg less LBM than at age 25, the female 5 kg less. Longitudinal observations show that this trend is for the most part biological, not secular in origin. The magnitude of the decline is such, and the sex difference in LBM great enough to suggest that age and sex should both be taken into account in such matters as drug dosage and nutritional requirements. (auth)

9209 (UR-49-1207) STUDIES ON THE BIOTRANSFORMATION OF METHYLMERCURY SALTS IN THE RAT. Norseth, Tor (Rochester Univ., N. Y.). 1969. 98p. Dep. CFSTI.
Thesis.

A study of the biotransformation of methylmercury salts in the rat was undertaken in order to get a better understanding of the mechanisms of toxicity and pharmacokinetics of these compounds. The biotransformation was followed by specific determination of inorganic mercury released from the intact organomercurial by cleavage of the carbon-mercury bond. A method was thus first developed for the analytical determination of inorganic mercury in the presence of methylmercury salts in biological samples. The toxic symptoms and signs produced by exposure to short chain alkylmercury salts were shown to be caused by the intact organomercurial, in this case, methylmercury compounds. Biotransformation was shown to be important for excretion of mercury after exposure to methylmercury chloride. About 40% of total mercury excretion was found to be inorganic mercury, 50% of fecal excretion, and from 5 to 20% of urinary excretion. Biotransformation within the intestinal lumen found in cecum was shown to be the major source of inorganic mercury in feces. Enterohepatic circulation of mercury was demonstrated after exposure to methylmercury chloride. Approximately ten percent of the dose was secreted in the bile during the first day, falling to approximately five percent the tenth day whereas only about three percent per day was excreted in feces over the same time period. The most prevalent form of mercury in bile was methylmercury cysteine and inorganic mercury bound to protein. The cysteine complex of the organomercurial is rapidly and almost completely reabsorbed across the small intestine, in contrast to inorganic mercury which is poorly absorbed. In other words a limited biotransformation in the liver accounts for a large proportion of the mercury excreted in feces. Enterohepatic circulation of mercury after exposure to methylmercury salts was shown to influence the organ distribution of mercury. Mercury in bile, complexed as methylmercury cysteine, was accumulated after reabsorption in the kidney to a higher degree than the originally injected methylmercury chloride. Tested on bile duct rats, this was demonstrated by a lower kidney content of mercury in these rats compared to the control rats, even if the content of mercury in blood and plasma increased. In the discussion the importance of these results was pointed out both for a more complete understanding of the toxicity and pharmacokinetics of methylmercury salts, representing the rather unique short chain alkylmercury compounds, and other similar organic mercury compounds, and for the clinical management of this form for mercury intoxications. (auth)

9210 (WERL-HOLOG-1) LASER TECHNIQUES FOR APPLICATION TO SURFACE TOPOGRAPHY AND ROUGHNESS MEASUREMENTS. Brandt, Gerald B. (Westinghouse Research Labs., Pittsburgh, Pa.). 18 Dec 1967. Contract AT(11-1)-Gen-14. 29p. Dep. CFSTI.

Four laser techniques, developed for the study of the topography and surface roughness of simulated corrosion sample surfaces, are discussed. Two methods using holographic contour generation provide depth information with approximately 10 micron resolution. Two laser scattering experiments provide roughness data. Experimental results and recommendations for further research are presented. (auth)

9211 EDUCATION AND TRAINING OF ENGINEERS IN THE NUCLEAR INDUSTRY. Proceedings of a Symposium Held in London, 5 December 1968. Proc. Inst. Mech. Eng. (London); 183: 1-60(1968-69). (CONF-681223).

Ten papers on the manpower needs of the nuclear industry are presented and an appraisal made of the training required for its engineers. The academic teaching available at universities, tech-

nical colleges, and industrial training organizations is described and constructive recommendations are made for possible improvements. Separate abstracts were prepared for each paper. (UK)

For abstracts of individual papers see: 9212–9221.

9212 UNIVERSITY TEACHING OF NUCLEAR ENGINEERING. Grant, P. J.; Murgatroyd, W. (Imperial Coll. of Science and Tech., London). Proc. Inst. Mech. Eng. (London); 183: 1-3 (1968-69).

From Symposium on Education and Training of Engineers in the Nuclear Industry, London, England. See CONF-681223.

Undergraduate and postgraduate training in nuclear engineering at British universities are reviewed. The lack of response by British industry to postgraduate courses is emphasized. Industry is invited to express its views on the suitability of the instruction and range of subjects studied at these courses, and to decide on their value compared with the training offered by industry itself. (UK)

9213 EDUCATION AND TRAINING OF ENGINEERS IN THE U.K.A.E.A. Hill, J. F. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. Inst. Mech. Eng. (London); 183: 4-7(1968-69).

From Symposium on Education and Training of Engineers in the Nuclear Industry, London, England. See CONF-681223.

The U.K.A.E.A. educates and trains its staff over a very wide range of staff and subject matter. A large amount of this is done internally in a number of schools and the arguments in favor of this are described and, in some detail, the way in which it is done. The different groups of the Authority vary somewhat in their methods of training, but the overall principles and objectives are similar. Particular attention is given to the education and training of already formally qualified engineers because it is in this area that there are differences from normal practice, and special training relevant to the nature of the atomic energy industry must be given. (auth)

9214 PRACTICAL TRAINING OF NAVAL ENGINEER OFFICERS AS NUCLEAR SUBMARINE POWER PLANT OPERATORS. Clack, N. B. M. (Admiralty Reactor Test Establishment, Dounreay, Scotland). Proc. Inst. Mech. Eng. (London); 183: 8-11(1968-69).

From Symposium on Education and Training of Engineers in the Nuclear Industry, London, England. See CONF-681223.

Further training of officers from the Nuclear Science and Technology Courses at the Royal Naval College at Greenwich is described. This practical training consists of about three months' formal operator training at the Admiralty Research Test Establishment at Dounreay, followed by about three months in a nuclear submarine. (UK)

9215 COURSES IN NUCLEAR SCIENCE AND TECHNOLOGY AT THE ROYAL NAVAL COLLEGE, GREENWICH. Edwards, J. (Royal Naval Coll., Greenwich, Eng.). Proc. Inst. Mech. Eng. (London); 183: 12-20(1968-69).

From Symposium on Education and Training of Engineers in the Nuclear Industry, London, England. See CONF-681223.

The academic nuclear training of naval officers and civilians in support of the Royal Navy's nuclear propulsion program is given in the Department of Nuclear Science and Technology at the Royal Naval College, Greenwich. The various nuclear courses at R.N.C., their aims, the topics covered, and the laboratory facilities available are described. The entry and the qualifying standards of the students are outlined. (auth)

9216 EXPERIENCE OF A POSTGRADUATE STUDENT IN THE NUCLEAR INDUSTRY. Barnes, S. A. (Central Electricity Generating Board, London). Proc. Inst. Mech. Eng. (London); 183: 21-3(1968-69).

From Symposium on Education and Training of Engineers in the Nuclear Industry, London, England. See CONF-681223.

The course of studies in nuclear power at the Imperial College of Science and Technology, London University, is critically discussed in relation to its relevance to the needs of the mechanical engineer in the nuclear industry. (UK)

9217 REQUIREMENTS FOR RESEARCH AND DEVELOPMENT ENGINEERS. Hadrill, H. F. J. (Central Electricity Generating Board, Southampton, Eng.); Jackson, R. F. Proc. Inst. Mech. Eng. (London); 183: 24-6(1968-69).

From Symposium on Education and Training of Engineers in the Nuclear Industry, London, England. See CONF-681223.

The role of the development engineer in any large organization, such as the nuclear industry, is described. Educational requirements and the practical training needed in relation to academic background are discussed. The scope for postgraduate training is considered. (UK)

9218 TRAINING OF NUCLEAR ENGINEERS IN THE FEDERAL GERMAN REPUBLIC. Marnet, C.; Wendt, P. (Brown Boverie et Cie., Mannheim, Ger.). Proc. Inst. Mech. Eng. (London); 183: 27-31(1968-69).

From Symposium on Education and Training of Engineers in the Nuclear Industry, London, England. See CONF-681223.

The basic training of engineers at technical colleges and universities is summarized. An outline is given of the nuclear engineering courses offered by the technical colleges, including the Euratom training program. Nuclear training at the technical universities and the place of nuclear engineering in the curricula are discussed. Facilities for further education are reviewed. (UK)

9219 TRAINING OF REACTOR OPERATING ENGINEERS IN THE C.E.G.B. Raikes, J. L.; Silverleaf, D. J.; Weeks, R. J. (Central Electricity Generating Board, London). Proc. Inst. Mech. Eng. (London); 183: 32-8(1968-69).

From Symposium on Education and Training of Engineers in the Nuclear Industry, London, England. See CONF-681223.

A brief historical summary of the development of nuclear training within the CEGB is given, together with a résumé of the training requirements. Existing training schemes are described and their success assessed against these requirements. Tentative proposals are made for modifying the existing schemes. (UK)

9220 INDUSTRIAL TRAINING AND THE NUCLEAR ENGINEER. Shaw, M. K. (English Electric Co. Ltd., Whetstone, Eng.). Proc. Inst. Mech. Eng. (London); 183: 39-41(1968-69).

From Symposium on Education and Training of Engineers in the Nuclear Industry, London, England. See CONF-681223.

The initial formal training of all mechanical engineers should contain instruction in some basic nuclear technology, including physics, special materials, safety, engineering in radioactive environments, reactor types, and basic control problems. The professional institutions should be encouraged to co-operate with the universities and technical colleges in formulating a basic syllabus. Students should be encouraged to pursue post-graduate work in related subjects, but this work should not become simply an extension of first degree work. Universities and technical colleges should establish a close relationship with industry and the government establishments so that research projects and practical work correspond to the industry's needs. Industry should provide the education which adapts the new graduate to local engineering conditions and traditions, and also provide imaginative programs. The organization structure should have the necessary flexibility to allow experience to grow and should not insist on too early a specialization. (auth)

9221 NUCLEAR ENGINEERING KNOWLEDGE REQUIRED BY PROJECT AND DESIGN ENGINEERS. Cartwright, H. (United Kingdom Atomic Energy Authority, Risley, Eng.). Proc. Inst. Mech. Eng. (London); 183: 42-7(1968-69).

From Symposium on Education and Training of Engineers in the Nuclear Industry, London, England. See CONF-681223.

The type of engineering work involved in the design and construction of all types of nuclear plant is discussed. It is concluded that the engineers need primarily to be skilled in established fields of engineering, followed by an understanding of the way in which nuclear fission and its consequences have added a new dimension to these fields. A specialist knowledge of nuclear reactor theory is required by those designing reactor cores. (UK)

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